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CONTENTS

APR 8 1935

STATISTICS AND LEVIATHAN — Frederick C. Mills — 1

FACTORS IN THE VARIATION OF CRIME AMONG CITIES — William F. Ogburn — 12

THE NATIONAL INCOME AND ITS DISTRIBUTION — W. L. Crum — 35

A GENERAL-PURPOSE CLASSIFICATION FOR MANUFACTURING INDUSTRIES — Ralph C. Epstein — 47

RECENT PROGRESS IN STATISTICAL METHOD — Paul R. Rider — 58

THE MECHANICS OF THE TABULATION OF THE POPULATION CENSUS — Leon E. Truesdell — 89

A FORMULA FOR FINDING THE SKEWNESS OF THE COMBINATION OF TWO OR MORE SAMPLES — William D. Baten — 95

NOTES — 99

REVIEWS — 117

MARCH, 1935 — VOL. XXX · NO. 189

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

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CONTENTS

STATISTICS AND LEVIATHAN. By Frederick C. Mills 1

FACTORS IN THE VARIATION OF CRIME AMONG CITIES. By William F. Ogburn 12

THE NATIONAL INCOME AND ITS DISTRIBUTION. By W. L. Crum 35

A GENERAL-PURPOSE CLASSIFICATION FOR MANUFACTURING INDUSTRIES. By Ralph C. Epstein 47

RECENT PROGRESS IN STATISTICAL METHOD. By Paul R. Rider 58

FEATURED NOTES

The Mechanics of the Tabulation of the Population Census. By Leon E. Truesdell 89

A Formula for Finding the Skewness of the Combination of Two or More Samples. By William D. Baten 95

NOTES

Should a Federal Monetary Authority be Established to Exercise Complete Control over the Currency? (99); Employment and Health (100); A Correction (102); Progress of Work in the Census Bureau (103); Development of the Activities of the American Statistical Association (102); Miscellaneous Notes (106); Members Added (114).

REVIEWS

Snedecor: *Calculation and Interpretation of Analysis of Variance and Co-variance*, by H. Hotelling (117); Fisher: *Statistical Methods for Research Workers*, by H. Hotelling (118); Fry: *The Technique of Social Investigation*, by G. A. Lundberg (118); Simiand: *Les Fluctuations Economiques A Longue Period et La Crise Mondiale*, by A. H. Hansen (120); Pietra and Fortunati: *Primi Lineamenti di Statistica Corporativa*, by A. W. Marget (122); Burns: *Production Trends in The United States Since 1870*, by T. O. Yntema (124); Beckhart, Smith, and Brown: *The New York Money Market*, by W. Thomas (124); Orchard and May: *Moneylending in Great Britain*, by W. T.

Continued on next page

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REVIEWS—Continued

Foster (129); Study by the League of Nations: *Taxation of Foreign and National Enterprises*, by C. Shoup (130); Currie: *The Supply and Control of Money in the United States*, by W. E. Spahr (131); Marshall and May: *The Divorce Court, Ohio*, by R. H. Abrams (133); National Industrial Conference Board: *Recent Developments in Industrial Group Insurance*, by M. Taylor (134); Penrose: *Population Theories and their Application with Special Reference to Japan*, by J. G. Smith (135); Chiao: *A Study of the Chinese Population*, by J. E. Orchard (137); Vakil and Munshi: *Industrial Policy of India*, by C. L. James (137); Labor Research Association: *Labor Fact Book II*, by J. M. Gillman (139); Hutchins: *Women Who Work*, by J. M. Gillman (139); Schmalz: *Operating Results of Department and Specialty Stores in 1933*, by L. H. Grinstead (140); Bureau of Business Research, Harvard University: *Expenses and Profits of Variety Chains in 1932*, by L. H. Grinstead (140); McNair: *Chain Store Expenses and Profits*, by L. H. Grinstead (140).

PAPERS AND PROCEEDINGS OF THE NINETY-SIXTH ANNUAL MEETING 143

(SUPPLEMENT TO THIS NUMBER)

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JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

STATISTICS AND LEVIATHAN[1]

BY FREDERICK C. MILLS, *Columbia University*

It is now almost three hundred years since Thomas Hobbes dissected the problems of political living and examined the nature of sovereignty, of liberty and of law. It is just twenty years since Graham Wallas explored the conditions of social life in an integrated world order. The Leviathan of Thomas Hobbes and the Great Society of Graham Wallas were alike in that they were organizations of men forced by the compulsion of external events to master the difficult arts of mass living, or to slip backward into civil strife and social confusion. But these arts were to be mastered, in the two cases, under radically different conditions. Two hundred and sixty years had brought a transformation in the ways in which men made their living, and in the relations among men that grew out of their economic activities. The scope of mass life had been enormously expanded, in this interval, and the character of private and of social activities had been revolutionized.

The years which have passed since Graham Wallas wrote have intensified older difficulties and have brought new and baffling complexities into social existence. The world order as Wallas knew it in 1914 has been profoundly modified. Its apparent stability has been shattered. War and resurgent nationalism have effaced the gains of generations in the arts of collective living. On the positive side, the change in the physical circumstances of life has proceeded at a high tempo. New elements have been conquered. Greater mastery has been won over the basic processes of production. Industrialization has proceeded on a world front. The machine and a far-reaching division of labor have created a host of new relations among men, and have tied more tightly together the elements of the social system. To

[1] Presidential address at the Ninety-sixth Annual Meeting of the American Statistical Association, Chicago, December 28, 1934.

the old problems of social life have been added those due to the emergence of an industrialized Leviathan. This artificial monster which, in its maturity, is the distinctive product of our times is at once a social organization and an economic structure. And the nature of this system—its working characteristics, its structural defects, its operating limitations—passes the comprehension of its human parts. This fact lies at the heart of our present economic confusion. It points the fundamental issue of contemporary life. Today we face the imperative question whether man can learn to think and act in a new dimension, largely alien to his inherited nature—the dimension opened by mass living.

This state of affairs, and the dilemmas to which it gives rise, will, I think, persist. The tendencies that have worked toward the industrialization of contemporary life make for non-recurring changes. The static economic relations and the semi-periodic fluctuations that have received major emphasis in economic literature are perhaps of less importance, viewed in long perspective, than are the persistent forces leading to permanent alterations in the conditions of economic life. The changes which have already occurred, then, are not to be looked upon as of the nature of rare mutations, to which we may slowly adapt ourselves. The compulsion of enduring change will continue to alter the structure of economic and of social life, and the task of adaptation will persist, in ever-changing but ever-pressing forms.

My primary concern tonight is with the problem of coördination and direction that is faced in a closely-knit industrial society. In some manner smooth working relations must be established among the elements of such a society. The conflicting interests of individuals must be reconciled. The whole must be directed toward socially desirable objectives. The science of statistics and the art of statistical practice have a major rôle to play in the solution of this problem, in any form of economic organization. They have a rôle of exceptional importance under existing conditions.

This rôle is that of providing an economic and social intelligence service adequate to our present needs—a reporting system touching every part of the complex structure of organized life. Problems of rare difficulty arise here. For we appear to stand today at a transitional stage in human development. The manifold social adjustments and economic adaptations that were achieved without design in the relatively recent past must, in increasing degree, be effected through deliberate, conscious effort. When we could believe that social cement for human-kind is of essentially the same type as that which binds the social insects together, there was no necessity that any person or

group should seek to define the attributes of social and economic systems, as working entities. The whole functioned independently of any possible social purpose on the part of its elements. How valid this concept may have been in the 18th and 19th centuries I do not venture to say. Certainly it is no longer valid today. Unfolding circumstance forces us to do consciously what may once have been achieved unconsciously. Leviathan must develop a central nervous system.

These ideas are familiar enough. I have ventured to present them because of their immediate bearing upon the obligations and responsibilities of the group assembled here tonight, in particular, the obligations and responsibilities of the statistician. In the mathematical refinement of his tools the statistician may seem, at times, to be a student of esoteric cults. He takes many forms and appears to the world of men in strange guises. In his social science incarnation, however, the statistician must remain as Noah Webster long since defined him—one versed in classified facts respecting the condition of the people in a state. His is the task of planning, administering and interpreting the intelligence services essential to the working of the Great Society of today.

I should far exceed the time at my disposal were I to attempt to outline a plan for a system of reporting services adapted to the needs of a modern industrial society. Indeed, for the undertaking of such a task, I should require far more knowledge and somewhat more presumption than I now possess. It is perhaps in order, however, to suggest some of the necessary characteristics of such a system.

By an economic intelligence service, and here I restrict myself to the economic realm, I mean a system of reporting designed to provide information concerning the working of the financial, productive and distributive systems, in all their parts and in all their inter-relations. Precisely what information is required at a given time depends upon the stage of industrial development attained, the relative place of competition, of private monopoly and of direct state activity and control, and, not least, upon the character of the questions we have the wit to ask. Changing questions and changing combinations of the elements of competition, monopoly and control will give rise to varying needs at different times. In a competitive regime information is needed for the intelligent conduct of economic activity by the participants in processes of production and exchange. The appraisals and the decisions necessary to the maintenance of perfect markets—or the approximations to such ideal states that may be realized in an imperfect world—are possible only on the basis of full knowledge.

When the bloom of free competition passes, when there arise barriers, restrictions and limitations upon the play of free choice, new and supremely important tasks fall upon the informational services. They must provide the factual materials upon which control and regulation must be based. For departure from a fully competitive system means that the mutual adjustment of working parts and the maintenance of a working balance among economic elements becomes more and more a matter of design and conscious action, less and less a matter of happy and unpremeditated conjuncture. Finally, and this is true under any system, informational services are necessary to provide detached observers with the data required for scientific analysis and appraisal.

In an economy partly free and partly controlled, of the type to which our present system conforms, the statistical services must meet a wide variety of needs. Over large areas of economic life we shall have continuing need of the innumerable unplanned adjustments that are effected through the activities of private enterprise. A steady flow of timely, accurate information concerning all the processes of an industrial economy should be available to the agents of such enterprise. The same flow of intelligence is needed by public authorities charged with responsibility for specific phases of regulation, and by those administrators and analysts who are concerned with the working of the economic system as a whole. Under existing conditions, moreover, adequate statistical information is necessary for the protection of the public. For regulation inevitably vests some of the attributes of monopoly in the industries regulated. When competition is limited, only full knowledge on the part of the public and its representatives will protect the consumer against exploitation.

The creation and the administration of an intelligence service designed to meet these diverse needs in an industrialized economy operating under conditions of partial control is a major task before social scientists today. In stressing the importance of this task I mean to make no plea for fact-gathering in the abstract, nor to enter that ancient controversy between inductive and deductive schools. I am concerned with more immediate problems and more specific urgencies. We have a system that is out of hand because we do not understand how it works. Neither academic economist nor public officer really knows what are the vital elements. We must blunder, by trial and error, in seeking to perform those directional services that have become necessary under existing conditions. We lack the organized procedures on which such services must be built.

We have, of course, beginnings, and good beginnings, in the infor-

mational systems provided today by public and private agencies, but our needs have outstripped our resources. Major deficiencies have been revealed under the stresses of the last five years. These are, in part, deficiencies in the scope and content of existing reporting services. There are major gaps in our knowledge of the present industrial structure and of current industrial processes. But these gaps, it is fair to say, are being steadily reduced. A number of efficient agencies, federal, state and private, have already laid the foundations of a comprehensive reporting system. Such a system will provide basic information, compiled annually or biennially, concerning our productive and distributive plant and its capital structure. Supplementing this, we shall have more timely reports covering, completely, the flow of goods and purchasing power and the current utilization of productive resources. Our task here is to expand and extend existing services, to fill major vacancies and to reduce the margins of error present in many of the estimates now released.

More important, perhaps, than defects of coverage are deficiencies in respect of the correlative character of the materials now provided by our statistical services. We do not have today that full and perfect comparability of records of capital investment, employment, production, stocks, prices, profits, and wage, dividend and interest disbursements that is necessary to the intelligent appraisal of economic conditions. Uniform accounting, uniform modes of industrial classification, uniformities in reporting procedures and the other uniformities essential to full comparability may never be achieved, but we must go much further in this direction than we have gone.

I have said that the creation of a system of reporting services is no task of mere data-gathering. More important, in the last analysis, is the development of an adequate technique of interpretation and use. For statistics are gathered and interpreted within a framework of ideas, guiding principles, standards and concepts, some consciously defined and objective, some unformulated but none the less real. The character of these underlying principles is a matter of direct concern to the statistician. He has a responsibility for the critical appraisal of the concepts current at any time. He is under obligation to contribute to the formulation of suitable objectives and the development of valid principles of interpretation.

These considerations have brought us to questions of personnel. It is probably inevitable that the powers and functions of the public services should expand, that the demands upon these services should steadily increase. Deeply moving currents of change have shaped our development in the direction of large aggregates, of closely in-

tegrated economic organizations, and these forces will not be reversed. Such mass living means a burden of public services. For responsibility in the creation and maintenance of essential intelligence services is a public responsibility. The personnel problem here involved is one of the most urgent before modern democracies.

In the days when the working of a bureaucracy touched the lives and activities of the people of the country at but few points, personnel problems in government services were of minor importance. It could be maintained with some justice, perhaps, that no special skills were required for the public service, that any person of average intelligence and training could perform the duties of a public servant. This, of course, has been a major argument of those who support the spoils system. We suffer today from the persistence of this view. Our social life, on its economic side, has been made over since the days of Andrew Jackson. The functions of government have increased many fold, and have been transformed in character, yet the old tradition persists. Today a continuing staff of experienced technicians in the departments of government is essential to the operation of the kind of industrial society we have developed. Some of the special personnel requirements of the last two years will pass, it is true, but the tendencies of generations will persist. Whether we like it or not the working of our social and economic systems will depend, in increasing degree, upon the efficiency of technical bureaus of the federal government.

In the face of this situation, and of needs more acute than ever in our past for properly qualified public servants, we find current conditions marked by some highly disturbing features. Trained men are finding a place, it is gratifying to note, in the technical organizations of the central government. But this favorable movement on the one flank is balanced, perhaps over-balanced, by a reverse movement on the other flank. The traditions of the spoils system have received new impetus and new sanctions in recent months. The ship of the New Deal is not manned exclusively by Galahads. Political considerations control a great mass of appointments. Under fairer skies this might be tolerated. It is a form of social suicide today.

I would venture a further comment on this matter. It is a notable and important fact that weakness, faulty organization, ineptitude and sheer dishonesty come to no clear head in the working of the public services. Although the replacement of experts by political appointees in a technical bureau of government would create a condition of general inefficiency, such inefficiency would be manifest only in diffused and intangible forms. It would probably not lead to a break-

down of social machinery, clearly attributable to recognized elements of inefficiency. Nor would the degree of inefficiency be open to accurate measurement. Interested persons would be aware of muddling ineptitude, but no sharp signal of breakdown would be given to citizens at large.

Here lies, I think, a problem we must somehow solve. Private enterprise possesses, at least, the touchstone of profit and loss. There may well be wide latitude for incapacity in competitive industry, but, late or soon, red entries must mark the presence of sustained inefficiency. What comparable criterion have we for the public services? Can we devise a test which will promptly reveal incapacity in the technical services of government, and measure the degree of incapacity? If we cannot, the Great Society may well founder upon the rocks of political spoils.

I can think of but one substitute for the rigorous testing of the public services which a social profit and loss account might provide. Between the administrators of such services and professional bodies of social scientists there must be kept open a channel for the continuing transmission of advice, criticism, comment and suggestion. There are many reasons why this objective criticism is needed by those engaged in the daily task of collecting and interpreting statistical records. Not the least of these arises out of the fact that statistics, in the mass, fall with deadening impact upon the human mind. For statistics, as I need not advise this audience, are really a lethal weapon. A pressing problem facing those in the intelligence services is how to offset this enervating influence, how to maintain a live, alert attitude toward the materials of their trade. A steady inflow of critical opinion offers one means of ensuring such an attitude.

But there are other reasons for the maintenance of close and continuing contacts between professional groups and those manning federal and state agencies. I have referred to the need of preserving high standards of integrity in the conduct of these agencies. In the present state of political ethics constant and critical oversight from scientific groups is needed to offset the pressures from other sources, pressures tending to weaken the statistical services of government. Again, the body of concepts needed to give direction to data-gathering activities and to provide guides to the interpretation of statistical records must be built up, largely, by members of professional groups not actively identified with public administration. Unless there is vitality of thought among those concerned with this body of economic and social concepts and unless this vitality is imparted, through direct contact, to those engaged in the administration of the intelligence

services, sterility and inertia will be hard to fight off. Such sterility and inertia threaten both groups, in the absence of close and constant contacts.

The maintenance of these contacts is distinctly a responsibility of the American Statistical Association. Its membership cuts across the usual lines of demarcation between the social sciences. The professional interests of its members, in respect of the substance of scientific inquiry, are, in the nature of things, more diverse than are those of other groups of social scientists. Administrative and technical problems of data-gathering and data-utilization are matters of particular concern to its members. Experiments over the long history of the Association point to useful modes of coöperation between an independent professional society and governmental agencies. My predecessor, Dr. Stuart Rice, was instrumental in beginning a new and fruitful chapter in this history of coöperation with public agencies, through the creation of the Committee on Government Statistics and Information Services. The establishment, on a more permanent basis, of means of effective contact between our Association and the informational services of the federal government is a task remaining to us.

The great human documents that deal with the problems of organized living have been born, in the main, in periods of turmoil and disorder. Plato, writing in an age of political chaos, outlined in the *Republic* an orderly mode of social life. Thomas Hobbes' treatise was described, by himself, as a "Discourse of Civil and Ecclesiastical Government occasioned by the disorders of the present time". Hobbes also, believing that Leviathan, generated by reason, might be destroyed at last by civil strife, was searching for the rules and conditions of orderly social living. In this coincidence of social disorder and of the appearance of blue prints of Utopia we have a manifestation of a conflict old in human history. On the one side we have an environment marked by flux and ceaseless change—a world in which disorder, irregularity, variation and difference are the continuing characteristics of existence. On the other side there is an unremitting pressure for order and security on the part of human-kind. There have been periods in our history when fortunate conjunctures allowed reasonable security to populations at large. But the sweep of history has perhaps more frequently brought change, diversity, conflict and disturbance, and with these social disorder and individual insecurity.

One of the transient periods when stability and security seemed part of a natural order was enjoyed in the western world for a single

generation prior to the Great War. So short is our perspective that this brief experience has led many of us to take order and security for granted. We feel that something which is ours, of right, has been taken from us by the disturbances of the last twenty years. But I think it clear, in the conspection of time, that the re-emergence in our generation of unsettling change as a dominating factor in the conditions of living is taking us closer than we were in pre-war years to a normal state of affairs. In the long span of history non-recurring change and diversity of motion have dominated human life. We live again, today, in an age marked by the occurrence of lasting modifications in the conditions of existence.

This ferment of change comes at a time when the institutions of social life in the western world have become more complex, more ponderous, more extensive in scope and influence than ever before in our history. New forms of mass living have developed. It is primarily in the economic realm that this is true. An industrial Leviathan, largely created during the preceding era of historically unwonted stability, is being exposed to a storm of change. This condition makes demands upon the human elements of this organization that are perhaps more pressing than in any earlier age. More insistently, in more compelling form than in the days of the Greek cities, or of the English Commonwealth, or of the pre-war world, these questions call for answers: Can men learn to think and act in the dimension opened by mass living? May social order and individual security be won in this dimension?

I would emphasize a word I have just used—that social order and individual security must be *won,* must be won anew by each generation. Order and security are not our birthrights. It was an easy thing to look to the "known, naturall Inclinations of Mankind" for the automatic creation of order, to accept the nice assumption of Mandeville that the granting of free play to private vices necessarily brought "publick benefits". But this was a grievously oversimplified view. Individual security must be aggressively won, and social order must be imposed upon our environment.

Where, then, are we to look for that regularity and order in the circumstances of living which seems to be a necessary condition of rational existence? How are we to achieve economic security in a world of ceaseless movement? I have no answers to these questions. But I have emphasized a necessary first step in any campaign directed toward the attainment of social order today. If we are to avoid that particular and most terrifying kind of chaos that develops when a highly integrated economy gets out of gear, we must develop intelli-

gence services adequate to the needs of an industrialized mode of living. Through such services we must acquire the detailed knowledge of the working attributes of our industrial system which we lack today. We need knowledge that will enable the human elements to adapt themselves to the requirements of a mechanized productive organization. We require knowledge—far more knowledge than we now have—if social control is not to incur hazards of disruption as great as those to which the unregulated system is exposed. Nor is this a mere technical task. This vast machine we have created must be directed toward objectives consistent with its own structure and with the human requirements it must serve.

There is no assurance in all this that order may be discovered and security born of these efforts. Perhaps the task before us exceeds our capacities. It may well be that we are asking more of nature than she will give, when we seek security in a universe of change. It may be that inherent limitations upon the degree of social activity of which man is capable may prevent the setting of social objectives, the coördination of our diverse individual activities and the mastering of the masses of statistics necessary to collective living in an industrial society. If this be so, and in the present state of the world no man may say that it is not, the modern Leviathan may go the way of his pre-historic predecessors. Then, when men again are living in a state of nature, naked, rude and barbarous, some traveler from New Zealand, standing on the ruins of the Commerce Building, may read our epitaph: "Here lies the body of Leviathan, dead of locomotor ataxia, complicated by a plethora of indigestible statistics."

Yet there is hope of a happier outcome. The disciplines inherent in industrial processes are themselves creating regularities in the working of the industrial system. Through adequate intelligence services more of these regularities will be discovered. Adaptation to them will lessen the operating frictions out of which social disorder grows. But we must go beyond this. We of this generation must proceed on the assumption that order in economic and social life may be achieved through conscious action, as well as through the compulsion of external events. Order, in some degree, is self-created. Order may be impressed upon the world in which we live. Not through blind action may this be done, not with naïve disregard of the essential nature of the system which has been built up through generations of cumulative change. Over-simplification in this direction may be as devastating in its effects as is a blind trusting to private vices to create public benefits. But through informed action,

action based upon a knowledge of the system with which we are dealing, we may *enforce* order in the behavior of that system.

Through the discovery of inherent regularities, then, and through the deliberate impressing of regularities upon a system we have learned to understand, we may hope to bind Leviathan, and to win order and security for our generation. Basic in any such program is the establishment of a system of intelligence services far superior to anything we possess today, and the development of personnel adequate to the demands of such a system.

This is a large order. The activities of the existing public services, alone, will not accomplish these tasks. Cloistered study, alone, will not accomplish these tasks. Their accomplishment is an obligation of all social scientists, and more particularly, I think, of those who belong to the statistical profession. This obligation will be a first lien upon our energies, in the years immediately before us.

FACTORS IN THE VARIATION OF CRIME AMONG CITIES

By William F. Ogburn,* *University of Chicago*

Crime rates vary from city to city. This paper is a study of factors that cause some cities to have higher rates than others. Many of these factors are not now measurable, especially those that are more readily subject to control, as for instance, the efficiency of the police force, the capability of judges, the effectiveness of the court system, or the union between politics and crime. On the other hand, data on other possible factors can be had in suitable form and for enough cities to make analyses. Such factors are the nativity of the population, size of cities, the excess of males, church membership, the extent of manufacturing, the size of family, rates of growth of population, the amount of rent paid, the average earnings per wage earner in manufacturing, home ownership. Some of these factors may effect crime rates, though they are not easily manageable for the purpose of diminishing crime.

The index used as a measure of crime: The data used to indicate crime rates were the total number of offenses known to the police of a city in 1930, for the following offenses: criminal homicide, rape, robbery, aggravated assault, burglary and larceny where the value was over $50, except that in the group of largest cities all larcenies irrespective of the amount were included.[1] The data were from the "Uniform Crime Reports" of the Department of Justice, and are generally considered to be the best indications we have of the number of crimes committed. By far the largest number of cases were of larcencies and burglaries, with robberies third, but much fewer. Variations in these crimes of theft quite overshadow in number the homicides, rape and assaults. In order to guard somewhat against possible defective reporting during the first year of the service, all cities were omitted from this study where the total number of offenses known to the police were greatly different in 1931 from the number in 1930.

The cities studied: The list of cities for which data were reported in 1930 was not very large and from this list selections had to be made. The first difficulty was the fact that the crime situation is different in small cities from what it is in large cities. In general the

* The author wishes to express appreciation for the services of Mr. A. J. Jaffe, not only for aid in the calculations but also for his service in general on the analysis.

[1] With regard to larcenies, rates for all crimes excluding all larcenies and also including all larcenies were quite highly correlated for the cities studied with rates for all crimes including only larcenies over $50.

larger the city the higher the crime rate. Hence, a series made up of large and small cities would have been heterogeneous, and furthermore, arrayed in classes of equal sizes, the range would have been large with many gaps without data, which would make difficult analysis by the correlation technique. For these reasons, it was desirable to deal in a single series with only cities of very nearly the same size. But cities of nearly the same size for which all the data were available proved to be quite a small sample. In an endeavor to overcome this difficulty, three samples of cities of different sizes were used. The first series was of 16 large cities [2] of around 500,000 inhabitants with a range from 250,000 to 578,000. The second sample was of 24 cities [3] from 100,000 to 168,000 and is referred to as the middle-sized cities. The third group was of still smaller cities from 36,000 to 58,000, the number being 22.[4] Cities from the Southern states were omitted because of the Negro population, to reduce further the heterogeneity.

The factors studied: For each of these groups of cities the crime rates were correlated with various factors in a search for the reasons why cities vary in their crime rates. The factors of which much use was made are listed below.

All data are for 1930 and all population samples are for ages fifteen years old and over unless otherwise stated.

a. *Crime rates.* The offenses, previously named, known to the police were divided by the population and expressed in numbers per 1,000 population. Means: 19.9, 8.3, 7.9; standard deviations: 7.9, 3.6, 4.8.

b. *Percentage of males.* The number of males was divided by the total population and expressed in numbers per 100. Means: 49.2, 48.9, 49.1; standard deviations: 1.3, 1.4, 2.3.

c. *Native whites of native parents.* The number of male native whites of native parents per 100 of the general population, male and female. Means: 22.8, 20.2, 24.9; standard deviations: 7.2, 8.0, 9.7.

[2] These cities were Milwaukee, Buffalo, Cincinnati, Minneapolis, Newark, Seattle, Indianapolis, Rochester, Portland, (Ore.), Denver, Columbus, Toledo, Akron, Providence, Oakland, Kansas City, (Mo.).

[3] Springfield, Mass.; Bridgeport, Conn.; Scranton, Pa.; Des Moines, Ia.; Salt Lake City, Utah; Paterson, N. J.; Albany. N. Y.; Trenton, N. J.; Erie, Pa.; Spokane, Wash.; Wichita, Kan.; Tacoma, Wash.; Wilmington, Del.; Peoria, Ill.; Canton, O.; South Bend, Ind.; Somerville, Mass.; El Paso, Tex.; Utica, N. Y.; Hartford, Mass.; Grand Rapids, Mich.; Fall River, Mass.; Elizabeth, N. J.; Cambridge, Mass.

[4] Fresno, Calif.; San Jose, Calif.; Stockton, Calif.; Pueblo, Colo.; Aurora, Ill.; Decatur, Ill.; Pittsfield, Mass.; Montclair, N. J.; Hamilton, O.; Lorain, O.; Portsmouth, O.; Warren, O.; Lancaster, Pa.; Cranston, R. I.; Woonsocket, R. I.; Madison, Wis.; Sheboygan, Wis.; Springfield, Mo.; Alameda, Calif.; Fitchburg, Mass.; Auburn, N. Y.; Zanesville, O.

d. *Foreign born.* The number of foreign born males divided by the total population and expressed in 100's. Means: 10.2, 12.1, 9.9; standard deviations: 4.6, 5.4, 5.9.

e. *Offspring of foreign born.* The number of males who are native born of foreign or mixed parentage, per 100 of the general population, males and females. Means: 13.1, 14.2, 12.1; standard deviations: 4.2, 4.2, 5.1.

f. *Rent.* The median rent paid for all rented homes in the city expressed in dollars per month. Means: 33.4, 30.7, 29.7; standard deviations: 4.6, 5.9, 8.7.

g. *Value of homes.* The median value expressed in dollars of all the homes in which the owners lived. Means: 6224, 6296, 5952; standard deviations: 1345, 2087, 2936.

h. *Young children.* The number of children under five years of age per 1,000 married women 15 to 44 years of age. This factor was highly correlated with the size of the family. It has been used by others as an index of the birth rate. Means: 481.4, 566.8, 555.1; standard deviations: 74.4, 80.0, 78.6.

i. *Small families.* The percentage of all families consisting of only two and three persons divided by the total number of families exclusive of families of one person. Means: 54.9, 50.3, 51.6; standard deviations: 5.3, 5.1, 5.0.

j. *Manufacturing.* The number of males and females 10 years of age and over engaged in manufacturing pursuits per 100 of the population. Means: 21.7, 23.0, 24.0; standard deviations: 4.3, 6.1, 7.8.

k. *Income tax payers.* The number of income tax payers per 100 of the population. Means: 8.1, 7.7, 7.6; standard deviations: 1.1, 1.5, 3.1.

m. *Population of city.* Number of persons 15 years of age and over in the city. Means: 282,687, 90,975, 35,064; standard deviations: 24,251, 14,963, 5,994.

n. *Negroes.* Number of Negroes per 100 of the population. Means: 4.7, 2.7, 2.6; standard deviations: 4.0, 2.9, 3.2.

o. *Rate of growth.* The population increase from 1920 to 1930 divided by the population in 1920, all ages. Means: 17.3, 14.9, 26.9; standard deviations: 6.8, 15.1, 15.0.

o'. *Increase in rate of growth.* The difference between percentages of growth from 1910 to 1920 and from 1920 to 1930. Means: –9.9, –14.0, –7.0; standard deviations: 8.4, 21.3, 27.7.

p. *Police.* The number of police department employees per 100 of

the population. Means: .216, .209, .150; standard deviations: .070, .073, .042.

q. *Home ownership.* Owned non-farm homes per 100 population. Means: 14.9, 14.5, 17.9; standard deviations: 2.7, 4.2, 2.9.

r. *Apartments.* Number of families per 100 families who live in buildings housing three or more families. Means: 19.6, 19.4, —; standard deviations: 12.4, 13.3, —. (A blank here and elsewhere indicates either that the calculation was not made or was not used in the study.)

s. *Married males.* Number of married males 20 to 44 years of age per 100 of the population. Means: 35.9, —, 35.2; standard deviations: 3.25, —, 3.73.

t. *Married persons.* Number of married persons per 100 of the population. Means: 59.6, 59.0, 60.6; standard deviations: 2.65, 1.72, 2.93.

u. *Age, 15–35.* Percentage of the population that is from 15 to 35 years of age. Means: 45.6, 46.7, 45.4; standard deviations: 3.07, 2.66, 3.25.

v. *Age, 20–35.* Percentage of the population that is from 20 to 35 years of age. Means: 34.8, 34.7, 33.8; standard deviations: 2.68, 2.28, 2.59.

x. *Church membership.* The number of church members in 1926 13 years of age and over per 100 of the estimated population 13 years of age and over in 1926. (The population increase from 1920 to 1926 was estimated as .6 of the increase from 1920 to 1930. The Jews were divided into age and church membership groups in the same ratios as the non-Jewish population.) Means: 41.6, 55.5, 54.7; standard deviations: 10.8, 11.6, 12.8.

y. *Wages.* Total payroll in 1929 in retail trade divided by the total number of full time employees combined with the total payroll in manufacturing excluding salaried employees divided by the average number of wage earners. In combining weights were the numbers employed. Means: 1,386, 1,340, 1,329; standard deviations: 87.8, 141.5, 135.0.

y′. *Increase in wages in manufacturing.* The difference between the average wage in 1919 and in 1929 in manufacturing divided by the average wage in manufacturing in 1919. Means: 16.6, 18.0, 15.8; standard deviations: 12.5, 11.3, 16.9.

THE PERCENTAGE OF MALES IN THE POPULATION

The first factor studied as a cause of variation in crime rates from city to city was the percentage of males fifteen years of age and over

TABLE OF ZERO CORRELATION COEFFICIENTS

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*m*	*n*	*o*	*o'*	*p*	*q*	*r*	*x*	*y*	*y'*	
a	L M S	+.44 +.24 +.55	+.44 +.31 +.27	−.34 −.41 −.11	−.54 −.51 −.34	−.14 −.38 −.24	−.10 −.34 −.39	−.31 −.05 −.50	+.32 +.21 +.53	−.20 −.41 −.38	−.18 −.04 −.09	−.35 −.32 +.36	+.51 −.36 −.09	−.11 +.27 −.07	−.46 −.30 −.53	+.11 −.52 −.17	−.05 +.25 +.04	+.09 −.21	−.14 −.30 −.28	+.23 +.19 +.06	−.29 −.33 −.38	*a*
b	L +.44 M +.24 S +.55		+.01 +.20 −.06	+.25 +.09 +.32	+.01 −.02 +.13	+.54 +.10 −.58	+.01 −.19	−.19 −.52 −.07		+.22 +.29 +.15		−.26 −.01 +.03	−.15 +.19 −.38	+.31 +.06 −.20	−.32 +.10 −.47	+.05 −.26 −.42	+.23		−.35 −.24	+.71 +.51 −.20		*b*
c	L +.44 M +.31 S +.27	+.01 +.20 −.06		−.92 −.87 −.94	−.93 −.74 −.92	−.28 +.01 −.21		−.54 −.60 −.29		−.30 −.14 −.27		−.36 −.19 +.36	+.55 +.21 +.23	+.38								*c*
d	L −.34 M −.41 S −.11	+.25 +.09 +.32	−.92 −.87 −.94		+.82 +.84 +.85	+.39 +.29 +.01		+.44 +.27 +.32		+.40 +.63 +.40		+.15 +.03 −.41	−.68 −.15 −.32	−.33 −.68 −.29	+.04 −.06	+.62 +.64 +.36	−.21 −.46 −.34		+.33 +.53 +.55	+.25 +.06 −.17		*d*
e	L −.54 M −.51 S −.34	+.01 −.02 +.13	−.93 −.74 −.92	+.82 +.84 +.85		+.28 +.22 +.05		+.52 +.31 +.32		+.31 +.44 +.33		+.45 +.04 −.33	−.67 −.38 −.47	−.21 −.57 −.24		+.55 +.51 +.35	−.22 −.28		+.40 +.44 +.45	+.04 −.12 −.21		*e*
f	L −.14 M −.38 S −.24	+.54 +.10 −.58	−.28 +.01 −.21	+.39 +.29 +.01	+.28 +.22 +.05		+.34 +.65	+.13 −.26 −.23	−.42 +.07 .00	+.36 +.03 −.37	+.27 +.58 +.83	+.19 +.24 −.01	−.19	+.28 +.05 +.50	−.39 +.26 −.07		+.26 −.13 +.13		+.01 −.02	+.66 +.65 +.76	+.19 +.30 +.27	*f*
g	L −.10 M −.34 S −.39	+.01 −.19				+.34 +.65		+.12 .00			+.34 +.57											*g*
h	L −.31 M −.05 S −.50	−.19 −.52 −.07	−.54 −.60 −.29	+.44 +.27 +.32	+.52 +.31 +.32	+.13 −.26 −.23	+.12 .00		−.93 −.71 −.83	+.74 +.22 +.81		+.10 −.18 −.35	−.06				−.59 −.48 −.49		+.85 +.63 +.52	+.05 −.42 −.24	+.52 −.08 +.12	*h*
i	L +.32 M +.21 S +.53					−.42 +.07 +.00		−.93 −.71 −.83									+.55 +.45		−.78 −.84			*i*
j	L −.20 M −.41 S −.38	+.22 +.29 +.15	−.30 −.14 −.27	+.40 +.63 +.40	+.31 +.44 +.33	+.36 +.03 −.37		+.74 +.22 +.81			+.24 −.09 −.37	+.02 −.02 −.34	−.14 +.06 −.21	−.16 −.26 −.36	+.08 −.06	+.21 +.34 +.06	−.21		+.49 +.45	+.51 +.01 −.51		*j*
k	L −.18 M −.04 S −.09					+.27 +.58 +.83	+.34 +.57			+.24 −.09 −.37										+.37 +.62 +.74		*k*
m	L −.35 M −.32 S +.36	−.26 −.01 +.03	−.36 −.19 +.36	+.15 +.03 −.41	+.45 +.04 −.33	+.19 +.24 −.01		+.10 −.18 −.35		+.02 −.02 −.34			+.07	+.04 +.06 +.27						+.06 +.11 −.02		*m*

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*m*	*n*	*o*	*o'*	*p*	*q*	*r*	*x*	*y*	*y'*	
n	L	+.51	—.15	+.55	—.68	—.67	—.19		—.06		—.14		+.07		—.02		+.01						*n*
	M	—.36	+.19	+.21	—.15	—.38					+.06				+.01								
	S	—.09	—.38	+.23	—.32	—.47					—.21				+.39								
o	L	—.11	+.31	+.38	—.33	—.21	+.28				—.16		+.04	—.02		—.12	—.58	+.48		—.61	+.53		*o*
	M	+.27	+.06		—.68	—.57	+.05				—.26		+.06	+.01		+.32	—.49	+.24		—.48	+.18		
	S	—.07	—.20		—.29	—.24	+.50				—.36		+.27	+.39		+.02	—.38	+.32		—.46	+.36		
o'	L	—.46	—.32		+.04		—.39				+.08				—.12		+.15	—.41				+.24	*o'*
	M	—.30	+.10		—.06		+.26				—.06				+.32		—.06	+.30			—.14	+.35	
	S	—.53	—.47				—.07								+.02		+.02	+.21			—.11	+.20	
p	L	+.11	+.05		+.62	+.55					+.21			+.01	—.58	+.15							*p*
	M	—.52	—.26		+.64	+.51					+.34				—.49	—.06							
	S	—.17	—.42		+.36	+.35					+.06				—.38	+.02							
q	L	—.05	+.23		—.21	—.22	+.26		—.59	+.55	—.21				+.48	—.41			—.69				*q*
	M	+.25			—.46	—.28	—.13		—.48	+.45					+.24	+.30			—.82				
	S	+.04			—.34		+.13		—.49						+.32	+.21							
r	L	+.09																—.69					*r*
	M	—.21																—.82					
	S																						
x	L	—.14	—.35		+.33	+.40	+.01		+.85	—.78	+.49				—.61								*x*
	M	—.30	—.24		+.53	+.44	—.02		+.63	—.84	+.45				—.48								
	S	—.28			+.55	+.45			+.52						—.46								
y	L	+.23	+.71		+.25	+.04	+.66		+.05		+.51	+.37	+.06		+.53								*y*
	M	+.19	+.51		+.06	—.12	+.65		—.42		+.01	+.62	+.11		+.18	—.14							
	S	+.06	—.20		—.17	—.21	+.76		—.24		—.51	+.74	—.02		+.36	—.11							
y'	L	—.29					+.19		+.52							+.24							*y'*
	M	—.33					+.30		—.08							+.35							
	S	—.38					+.27		+.12							+.20							

KEY TO CODE LETTERS

L. Large Cities
M. Medium Cities
S. Small Cities

a. Crime Rates
b. Percentage of Males
c. Native White of Native Parents
d. Foreign Born
e. Offspring of Foreign Born
f. Rent
g. Value of Dwellings
h. Young Children
i. Small Families
j. Manufacturing
k. Income Tax Payers
m. Size of Cities
n. Negro
o. Rate of Growth
o'. Increase in Rate of Growth
p. Police
q. Home Ownership
r. Apartments
x. Church Membership
y. Wages
y'. Increase in Wages

in the population. It is known that crime is rare among women. Hence it seemed probable that cities with larger percentages of males in the population would have higher crime rates. Such is the case for each of the three groups of cities, as shown by the following coefficients of correlation: +.44, +.24, +.55, the first coefficient being for the largest cities. If the true correlation between crime rates and the percentage of males was the same in each of these classes of cities, then these three coefficients could be combined into one coefficient with a value of +.42, which is very nearly the arithmetic mean of the three coefficients above weighted by the number of cases. The error under this assumption is that of a coefficient of correlation obtained from 56 cases, and in this case is .11. Another way of expressing the relationship between the crime rates of cities and the percentage of males is to say that a large city whose percentage of males in the adult population is greater by 10 than that of another city has on the average a crime rate (including larcenies under $50) per 1,000 adults greater by 25. For the medium-sized cities the crime rate would be greater by 6 and for the small cities by 11.

The influence of the sex ratio on crime would be even greater were it not for the presence of the foreign born in cities, for among immigrants there are generally more males than females. If the percentage of foreign born is held constant, the partial correlations are +.58, +.30, +.63.

When other factors are held constant, the positive correlations persist.[5] When seven other factors [6] were held constant the Betas (regression coefficients in the equation divided by the ratio of their standard deviations) were positive: —, +.36, +.20. The factors held constant were foreign born, offspring of foreign born, rent, increase in rate of growth, church membership and increase in wages. It is clear then that one reason why some cities have more or less crime than others is due in part to the fact that they have higher or lower percentages of males in the population.

AGE AND MARRIAGE

It is known of course that age is highly correlated with crime. The rate is low among the very young and among the old, although the

[5] The partial correlations with the factor of offspring of foreign born, represented by the symbol, e, held constant are +.53, +.30, +.63. Other partial coefficients are the following where the letter designates the factor held constant: j, +.53, +.40, +.67; c, +.48, +.15, +.49; f, +.51, +.30, +.53; h, +.44, +.25, +.60; m, +.38, +.24, +.58; n, +.42, +.33, +.56.

[6] The equations are:

$$a = -5.311 + .523b - .020d - .212e - .150f - .046o' - .078x - .026y'$$

$$a = -23.282 + .731b - .116d - .305e + .015f - .062o' + .004x - .063y'$$

different crimes have different age distributions for prisoners. Yet it appears that the various cities differ not enough in their age distributions to show that age is a significant factor in explaining why one city has greater rates than another. At least the different indexes of age do not yield any correlation. If we take the per cent of the population from 20 to 35 years of age and correlate these per cents with the crime rates, the coefficients are +.02, +.32, —.13 for the three groups of cities, the group of large cities being placed first. And if the age groups 15 to 35 is used the correlations are —.03, +.27, —.16. Perhaps a consideration of other factors would modify these correlations somewhat, but probably not enough to show a very significant relationship.

On the other hand, the variability in age distributions from one city to another is not very great. For instance in the group of large cities the lowest per cent of the population from 15 to 35 is 42 and the highest is 53. A little computation will show that this variation in age distribution will not produce very much variation in the crime rate, as is shown in the remainder of this paragraph. The rate of commitments to prisons for the age group 15 to 35 is probably about three times as great as for the age group 35 years of age and over. If we suppose then the crime rate for the average city with 46 per cent of its adult population from 15 to 35 years of age is 30 per 1,000 for the age group 15 to 35 and is 10 for the age group 35 and over, the crime rate for the city will be 19. Now if these same rates are applied to the city with the youngest population, with 53 percent of its population between 15 and 35, the crime rate becomes 21; and for the city of oldest inhabitants with only 42 per cent from 15 to 35, then the crime rate is 18. In other words, the most extreme variations in age distribution produce only a variation of 3 in crime rates, whereas the total range of variation for crime rates in this group of cities is 24.

It is quite possible then that the variation between cities in age groups is too small to yield an appreciable correlation with crime rates. The point is important because in comparing other phenomena than crime, such as death rates or marriage rates, the age factor is found to be very important and needs to be standardized before other factors can be adequately isolated. But apparently in the case of crime rates, smoothing out the age factor is not so important.

The same analysis applies to the married population, who commit less crime than the unmarried. The total range of variations in the large cities, for instance, in the percentage married is only from 54 to 63. In the case of the sex ratio, while the variations are small, computations similar to those above show that about one third of the

total variability is explained by the range of variability in the sex ratio. The reason why so small a variability in the sex ratio is so significant in accounting for the total variability is the very high rate of criminal offenses among males as compared with that among females, a ratio of about 12 to 1.

So while we know that the young commit more crimes than the old and that the single are more often offenders than the married, yet the variation in these factors from city to city appears hardly large enough to account for much of the large variation that exists in crime rates.

IMMIGRANTS

There has been a good deal of research on the subject of immigrants and crime, which need not here be cited. In general, the evidence is that among prisoners and among convictions there is a smaller percentage of immigrants than in the general population, when age, marital condition and certain other factors are constant. The data on crime rates in cities when classified according to the percentage of immigrants are in agreement with these conclusions. The coefficients of correlation between crime rates and the percentages of foreign born are —.34, —.41, —.11.

By way of further exploration of the meaning of the fact that cities with large percentages of foreign born have lower crime rates, it is recalled that the percentage of males is high among the foreign born and that cities with excesses of males have higher crime rates. Hence among cities that have the same percentages of males, cities with large numbers of immigrants have relatively still lower crime rates than when the percentages of males vary. The coefficients of correlation between the percentages of foreign born and crime rates, having the percentage of males constant, are —.52, —.44, —.36.

In general these negative correlations between immigrants and crime rates hold up when other factors are held constant. But there is interest in certain factors in particular. Considering first the factor of children, cities with larger percentages of young children have lower crime rates and also more foreign born. When the young children are held constant, the correlations become —.24, —.41, +.06. In the case of the smaller cities, where the correlation just shown is +.06, if the sex ratio is held constant in addition to the factor of young children, the correlation becomes —.21. Not all therefore of the correlation between low crime rates and immigration can be attributed to the presence of a large number of young children.

A similar conclusion is reached when church membership is studied in relation to immigration and to crime. If the percentage of church

members were the same in all cities, the cities with more foreign born would still have lower crime rates; the partial coefficients being —.31, —.30, +.06.

The factor of increase in rate of growth which was found to be significantly correlated with crime rates is not, however, correlated with immigrants. The same is true with increases in wages. All these tests [7] indicate that the immigrants have lower crime rates than the general population. However, there is one other factor that should be examined. It is the native born children of foreign born or mixed parentage, referred to hereinafter as the offspring of immigrants. Indeed, the relationship between crime and the offspring of immigrants is itself a question of importance, quite equal to that of the relationship of crime and the foreign born.

The opinion seems to be that crime rates are higher among the children of immigrants than among the foreign born and indeed than among the native born of native parents. But the statistical evidence and proof do not seem to be conclusive. In any case, for the data under discussion, cities with the larger percentages of the offspring of foreign born have lower crime rates. The correlations, —.54, —.51, —.34, are higher than the correlations with the foreign born and are about the same as the correlations with the foreign born when the percentage of males is held constant. The sex ratio of the offspring of foreign born is like that of the general population and different from that of the foreign born.

In considering these correlations it is remembered that the offspring of immigrants live in the same cities as the immigrants, the correlations being +.82, +.84, and +.85. Hence zero order correlations do not differentiate very well between the influences of the foreign born and the influences of their offspring. Holding the percentages of foreign born and the percentages of males constant, the correlations between crime rates and the percentage of offspring of immigrants are still negative, —.36, —.32, —.40. The age distribution of the offspring of immigrants is about the same as that of the native born of native parents. Furthermore, these negative correlations persist to a significant degree when other factors are separately held constant.[8]

The current opinion on the relationship of offspring of immigrants and crime, which is different from the indications of the foregoing

[7] Other partial correlation coefficients between crime rates and the percentages of foreign born are the following where the letter signifies the factor held constant: m, —.31, —.42, —.04; j, —.29, —.21, —.05; n, .00, —.50, —.15; n —.53, —.11, .06; hx, —.22, —.44, —.36.

[8] The partial correlations are the following where the letters indicate the factor held constant: j, —.51, —.40, —.24; h, —.47, —.52, —.22; m, —.46, —.52, —.25; n, —.31, —.75, —.43; x, —.53, —.44, —.24.

correlations, is based in many of the cases on the prison statistics showing rates per 1,000 population of the state or the nation 15 or 20 years of age and over. Since the denominators of these percentages include the rural population in which there are much larger percentages of the native born of native parents than of the offspring of immigrants, and since the numerators are drawn more largely from the cities, these percentages based on the prisons' statistics make the crime rates of the offspring of immigrants appear larger than they should be in comparison with those of the general population. Current opinion of "second generation immigrants" and crime is, in other cases, based upon rates drawn from urban populations in a very limited number of cities. But even in these rates the age factor is not held constant. This probably does not affect much the comparisons with the native born of native parents, but it probably does for recent data the comparisons with the foreign born since the latter are probably older. Finally current opinion is drawn from juvenile court records which are not comparable with our data because of age.

In seeking to explain this unsuspected high negative correlation between crime rates and the offspring of foreign born, which is contrary to general opinion, it was thought it might have been due to the presence of older groups of offspring in our data. The average date of birth of these offspring of immigrants was around the beginning of the century. But when the percentages of the offspring of the foreign born and of the immigrants, of ages from 15 to 35 years, are correlated each with crime rates, the results show a greater correlation of crime rates with the offspring than with the immigrants. This fact indicates that age does not explain the higher correlation with the offspring. The data, then, here submitted show that among these cities with the same percentages of foreign born, cities with larger percentages of offspring of foreign born have lower crime rates.

The next step is to seek the influence of the percentages of foreign born on crime rates, when the influence of the offspring is removed. The correlations are negligible but positive: +.07, .00, +.17. However, when the six other factors (listed under the discussion of the percentage of males on a preceding page) the Beta coefficients are negative:—, —.03, —.14, but are still smaller than the Beta coefficients from the same equation for the offspring:—, —.24, —.32. It would seem probable then, that cities with larger percentages of foreign born have lower crime rates, when the percentage of offspring is held constant. Yet the correlations with crime rates are higher with the percentages of offspring when the influences of the foreign born are removed.

Why the influence of the children of immigrants in producing lower crime rates is greater than the influence of immigrants is not explained by the arrays in the basic correlation tables. The outlying marginal cities in the table are a few cities with Mexicans and Japanese who are not listed among the foreign born whites, and also some cities which are in close proximity to other cities, as for instance Newark, N. J. Withdrawing these cities does not change the situation, that is, does not show a greater influence of immigrants on low crime rates than of their offspring.

The coefficients of part correlation, like those of partial correlation, show higher correlations with the offspring of foreign born than with the foreign born.

It is, of course, possible that in the variety of nationalities of immigrants during the past half century may be found the explanation of why the correlations are higher with the offspring of foreign born. This suggestion indicates that the term immigrant is a blanket term to cover a group of factors such as: religion, high birth rates, unequal sex ratios, and others which can be measured but others such as nationality traits, customs, and others that cannot very well be measured. When, therefore, the percentage of offspring of immigrants is held constant the variability contributed by these unmeasured associated factors are subtracted from both the variability of crime rates and the variability of immigrants also, hence the partial coefficients are low. In other words, to get a full explanation, the terms immigrant and offspring of immigrants would have to be broken down into still more measurable factors. This is a point that is applicable to the various other correlations. Hence the desirability of considering a number of factors, which of course adds to the complexity. Variables, as immigration, would seem to have many such associated factors, while others, such as the sex ratio, would seem to have fewer.

It is recalled that some of these unmeasured factors may differ in the older groups of Germans, Scandanavian, Irish and English in such cities as Milwaukee, Minneapolis and others in our list from what they do in some of the more recent slum areas of the few cities where most studies of crime and the offspring of immigrants have been studied, and upon which the current opinion is based. Probably most persons in speaking of the second generation immigrants and crime are not thinking about the offspring of these older groups. In any case, the set-up of factors in this paper show that the presence of offspring of immigrants is more effective in keeping crime rates low

than the presence of the foreign born. The data and analysis are submitted for what other interpretation the reader may wish to make.

But whatever the associated factors with immigrants and with the offspring of immigrants may be, the coefficients of multiple correlation between crime on the one hand and the percentages of immigrants and of offspring (with the other non-isolated factors associated with them) on the other hand are .57, .52, .47. Even if our technique should not be very successful in isolating the component variables in the factor of immigration, we can conclude that a very important factor in explaining why some cities have higher crime rates than others is the presence of immigrants and their offspring.

CHURCH MEMBERSHIP

Since religious persons are not supposed to commit crimes, one might expect cities with more church members to have for that reason less crime. Church membership figures are, however, not as satisfactory as we wish because of different methods used by various denominations in compiling them. These methods are different, for instance, between the Roman Catholics and the Protestants. The young people from 13 years of age on in Roman Catholic families are counted as church members while in the Protestant families a young person is not counted as a church member unless he definitely joins the church by some act of profession. Since there are large numbers of Catholics in our cities, the churches with large percentages of church members thus measured would seem to be in general cities with high percentages of Catholics. To this weighting of church membership in favor of Catholics, a Catholic might reply that young people in Catholic families may be more closely identified with the church than children in Protestant families who have not yet joined the church. So, then, such figures on church membership are either comparable or else the cities with the highest membership figures represent cities with the largest per cent of Catholics. Using this index of church membership in spite of differences between Protestants and Catholics, cities with larger church memberships are found to have lower crime rates, the coefficients of correlation being —.14, —.30, —.28. Assuming equally correlated relationships in the three classes of cities, the estimated value of the correlation is —.25 and the probability that the true correlation is negative is about 95 out of a 100.

An explanatory factor that should be considered in this connection is the growth in population of cities. For the cities with the greatest rates of growth have the smallest percentages of church members. Apparently when a person moves to a city he delays transferring his

church membership. The correlations are —.61, —.48, —.45. When the rate of growth is held constant the correlations between church membership and crime rates become —.27, —.21, —.35, a still higher relationship between religion and low crime rates.

Since a good many foreign born are Catholics, we find that the cities with large church membership rolls are also cities with large percentages of foreign born, the correlations being +.33, +.53, +.55. The correlations between crime rates and church membership may, therefore, represent merely correlations between crime rates and the percentage of the foreign born. Holding the percentage of foreign born constant, the correlations between church membership and crime rates become —.03, —.11 and —.27. When both rates of growth and the percentages of foreign born are held constant, the correlations are —.21, —.09, —.34. Religion as measured by church membership seems to be a slight factor in accounting for low crime rates even when the foreign born are held constant.

There is another possible factor for which religion may be a symbol. It is the number of young children. The cities with the greatest percentage of church members are the cities with the greatest numbers of young children. The correlations are +.85, +.63 and +.52. Could it be that the cities with more church members have less crime because they are the cities with more children? By holding constant the percentages of young children, the correlations become +.25, —.35, —.04, and if, at the same time the percentages of young children are constant, we also eliminate the influences of growth, the partial coefficients are +.13, —.26, —.15. In other words, where the percentages of young children are the same, there is no clear correlation between religion and crime. It would seem therefore that it is either the children or the religion which is associated with children that is correlated with less crime.

When still other factors are held constant, these conclusions are not significantly affected.[9] The correlation between cities with large church membership and low crime rates is due in part to the presence of the foreign born and of young children. When these factors are held constant the correlations though generally negative are too low to prove a correlation with the number of cities here studied.

SMALL FAMILIES AND THE BIRTH RATE

Cities with larger percentages of small families have higher crime rates as shown by the following correlation coefficients: +.32, +.21,

[9] Partial correlation coefficients: b, —, —.26, —; e, —.09, —.10, —.15; j, —.05, —.15, —; i, —.19, —.24, —; f, —.02, —.26, —. The Beta coefficients in the eight variable equations listed in a previous note are —, —.25, +.01.

+.53. The size of family includes relatives living with the family as well as children. But since the number of relatives is small per family, it is the number of children that causes the size of the family to vary most. Another similar index was also used, the number of children under 5 years of age per 1,000 married women 15 to 44 years of age. This index is used also in some studies as an indication of the birth rate. The cities with the larger percentages of young children have lower crime rates, as indicated by the coefficients —.31, —.05, —.50.

Why should cities with more children or larger families have lower crime rates? Before deciding that it is due to some spiritual quality of family life or the humanizing influence of children in the home, it is desirable to inquire whether other factors may not explain the relationship. Since families of foreign born have more children than the native born, (the correlations are +.44, +.27, +.32), holding the percentage of foreign born constant the correlations are reduced to —.19, +.07, and —.49, hardly a significant correlation except possibly in the smaller cities.

Another possible factor is church membership. For the cities with the larger percentages of its population church members have more children (+.85, +.63, +.52) and less crime (—.14, —.30, —.28). Holding the factor of church membership constant reduces the correlation between percentage of children and crime rates to —.37, +.20, —.43.

The factor of manufacturing works out as does the factor of the foreign born and the factor of religion, but the factor of manufacturing is in turn largely explained by the foreign born and the church membership, as will be shown later.

It hardly seemed necessary to work out the correlations with family size since it correlates with the number of young children quite highly, +.93, +.71, +.83.

It thus appears that the reason why cities with large families or a high birth rate [10] have less crime is due to the presence of the foreign born and of church members.

MANUFACTURING

Cities with the larger proportions of its working population engaged in manufacturing have lower crime rates. The correlations are —.20, —.41, —.38. Why, among the cities of our sample, those with larger percentages engaged in trade, transportation, the profes-

[10] Other partial correlation coefficients are the following: b, —.26, +.09, —.56; e, —.04, +.14, —.44; f, —.30, .00, —.54; j, —.24, +.05, —.35.

sions, and occupations other than manufacturing should have higher crime rates than cities whose populations are more largely engaged in manufacturing is not obvious. Is it possible that life with machines in factories is less conducive to crime? Such a conclusion seems rather improbable. So it is desirable to see whether manufacturing is not a symbol for some other influence.

Generally cities with the most employment in factories have the largest percentages of males. Holding the sex ratio constant, though, raises the coefficients to —.34, —.52, —.56. If it were not for the excesses of males in manufacturing centers the crime rates would be still lower.

Manufacturing depends a good deal on immigrant labor, and the cities with more foreign born have lower crime rates. Hence, holding the percentage of foreign born constant reduces the coefficients a good deal, to —.08, —.21, —.37. The effect of holding constant the percentage of the offspring of the foreign born is about the same as holding the foreign born constant. When cities then have the same percentage of foreign born or of their offspring, the cities with a good deal of manufacturing have less crime, but not as much less as when the percentage of immigrants and of their children are not left the same. From the sizes of the coefficients a very large part of the association of manufacturing with low crime rates is due to the presence in manufacturing cities of the immigrant and offspring.

Manufacturing centers also have larger numbers of church members, (+.49, +.45, —.), hence the correlation between low crime rates and manufacturing might be due to the religious factor. Holding the percentage of church members constant does not, though, reduce the partials to zero. They are —.16, —.32, —. .

Another possible assumption is that manufacturing is an index for a high economic status. Since, in general, better economic conditions are associated with less crime, then these correlations of crime with manufacturing may merely mean that crime is lower with higher economic status. But the conclusion from this analysis does not hold for in these cities there is no correlation of manufacturing with our index of wages, if such may be considered an economic index. The coefficients are +.50, +.01, —.51. Manufacturing cities are, though, negatively correlated with another possible economic index, rates of growth: —.16, —.26, —.36, (perhaps due to the decentralization of industry), but holding growth constant does not alter the coefficients very much. There is no correlation of manufacturing cities with cities which have a large percentage of income tax payers. We have not been successful then in attributing the negative correlation of

crime rates with large percentages employed in manufacturing to an economic factor.

One other possible interpretation [11] may be examined. The manufacturing cities have a large per cent of young children. The correlations are +.74, +.22, +.81. And the cities with many young children also have low crime rates. Indeed, keeping constant the number of young children just about removes the correlation between manufacturing and crime, the coefficients being —.04, —.41, +.04.

The conclusion then is that, while in our samples, cities with more manufacturing have less crime, this fact seems to be due largely to church membership and the presence of immigrants and young children.

INCOME

There is reason to think that income and crime are related since there are so many thefts, but it is probably quite difficult to determine out of the complexities of such a possible relationship what are the specific factors in urban crime rates. Crime has been shown to be greater in periods of depression, but here habits of life are suddenly changed by reduced incomes and unemployment. As to whether cities with higher wages would have less crime than those with lower wages is another situation. For if conditions have been stable for some time, adjustments have been worked out between wages and costs-of-living, particularly rentals and land values. At any rate the coefficients of correlation between wages and crime rates are positive: +.11, +.19, +.06 but low, suggesting, however, that cities with higher wages may have more crime. This result is opposite to what was expected and needs to be examined further.

There may be some doubt as to whether we have a sufficiently adequate index of wages. The index is a weighted average of the average annual retail earnings and the average annual manufacturing earnings. Both these averages were determined by dividing the total payroll for the year by the average number of wage earners. In the case of manufacturing it was the average number on the weekly payroll taken once each month of skilled and unskilled labor. For retail stores it was the full-time employees. It is seen that these figures neglect the sex factor and the part-time factor. The requirements for precision are not so great, however, when differentials between cities are sought as in determining a fully defined wage figure. By way of testing the index, it may be noted that it corre-

[11] Other partial coefficients are: e, —.04, —.24, —.30; f, +.04, —.43, —.52; m, —.21, —.43, —.23; n, —.16, —.41, —.41.

lates positively with per cent of income tax payers; +.37, +.62, +.74; and positively with rent: +.66, +.65, +.76; and positively with growth: +.53, +.18, +.36. From these correlations one would hesitate to attribute positive or zero correlations of this wage index with crime as being due to the inadequacy of the wage index.

One possibly disturbing factor in this correlation may be sex. Men get higher wages than women. Hence it is desirable to hold the sex factor constant. When this is done the correlations become —.32, +.08, and +.32, an uncertain result.

By way of further examination, if labor were highly mobile and if the cities compared were all close together, differences in wage levels might more probably be correlated with crime. But, in general, differences in wage levels would not seem to be as important a factor in variations in crime rates as changes in wage levels. Such a change in wage levels, is, of course, what happens in a depression.

By comparing the average manufacturing wage in 1919 with that in 1929 by cities we have a possible index of increases (and decreases) in wage levels in cities. The correlations with the crime rates are —.29, —.33, and —.38, and are not affected appreciably by holding constant changes in rates of growth. By this criterion, cities with increasing wages, as defined, have less crime and those with declining wages have more crime. This conclusion is sustained by the Beta coefficients, previously referred to, which are negative:—, —.08, —.23. It is noted that the influence of another economic factor, change in rate of growth, has been removed from these Beta coefficients.

Another index of the wealth of a city is the percentages of the population that are income tax payers.[12] This index correlates with wages +.37, +.62, +.74 and with rent +.27, +.58, +.83, but the correlations with crime rates are insignificant: —.16, —.04, —.09 though the signs are negative. It is recalled that neither wages nor rates of growth had significant correlations with crime rates but that the rates of change in these two variables did have significant correlations. Perhaps rates of change in numbers of income tax payers might show significant correlations, if data were available.

No index of unemployment was available. That of the Census of April 1930 can be shown not to be a suitable index for the whole year.

The conclusion from the data available on earnings in the cities is that the greater their increase the less crime there is.

[12] The data on income tax payers are from "Population and Its Distribution," Fifth Edition, 1931, published by the J. Walter Thompson Company.

RENT

The average rent paid in a city is negatively correlated with crime rates. The correlations are —.14, —.38, —.24. So also the higher the value of the owned homes the less the crime, the correlations being —.10, —.34, and —.39. Why do cities with higher rents have less crime? It seems logical to consider rents an economic index, for we know that the higher the earnings, the more rent there is paid. Rent is correlated with wages fairly highly: +.66, +.65, and +.76, and also with the per cent of income tax payers: +.27, +.58, +.83. Furthermore, rents are positively correlated with rates of growth. So, therefore, we may be justified in thinking of rent as an economic index.

That rent may be something other than an economic index is suggested by the high correlations when wages are held constant: —.36, —.68, —.43. Higher rents when wages are the same might be considered a greater appreciation of home and community life and this might be the reason for so high a relationship with low crime rates.

On the other hand, when the percentage of young children is held constant, the correlations between crime rates and rents become —.10, —.40, —.42.

The Beta coefficients are, however, uncertain:—, —.25, +.03, and hence despite the large number of negative partial correlations one hesitates to claim that the rent factor has been sufficiently isolated to show for sure a correlation with low crime rates. It should be noted, however, that the influence of two other economic factors, change in wages and change in rates of growth, have been removed. Hence it seems very probable that low crime rates are found with high rents, when rent is taken as an economic factor.

HOME OWNERSHIP

The cities with larger percentages of their families living in their own owned homes do not seem to have either lower or higher crime rates; the correlations are —.05, +.25, +.04. In all cities, particularly the larger ones, there are many apartment houses, and the apartments are seldom owned by the families that live in them; the correlations between home ownership and the percentage of families living in apartments are —.69, for the large cities and —.82 for the middle sized cities. (The correlations were not worked out for the small cities because the percentage of apartments were quite low except for two cities where the percentage living in apartments was several times the average for all the cities.) But holding the per-

centage of apartments constant does not alter the correlations very much because they have no correlation with crime rates.

Home ownership is negatively correlated with the percentage of foreign born: —.21, —.46, —.34, and with the number of young children: —.59, —.48, —.49, and these are two groups with low crime rates. Hence holding the percentages of foreign born constant, the percentage of families with young children constant makes a negative correlation between home ownership and crime rates for the large and small cities but not for the middle-sized cities: —.20, +.15, —.06, and —.31, +.26, —.

Home ownership is positively correlated with rates of growth: +.48, +.24, +.32, but since this variable is not correlated with crime, holding it constant does not affect very much the correlations between home ownership and crime.

GROWTH OF POPULATION

New and rapidly growing towns are supposed to attract the adventurous and the lawless. At least such an idea comes to us from the stories regarding the unsettled west and the mining camps. A moderate rate of growth for an organized town may not present such characteristics, however. The coefficients of correlation do not indicate any correlation between high crime rates and growth, the coefficients being —.11, +.27 and —.07. The theory that rapid growth attracts the lawless before law and order are installed seems to be partly true in that the more rapidly growing towns have fewer police per 10,000 inhabitants. The correlations for these cities are —.58, —.49 and —.38. The interpretation is that population growth precedes law and order, i.e., the necessary additions to the police force. It is desirable to see what the correlations between crime rates and growth would be if there was no such variation in the ratio of police to population. Holding the percentage of police constant the correlations become —.06, +.02, —.14. Still no relationship between rates of growth and rates of crime is shown.

It is observed that, though a city may be growing fairly rapidly, it may not be growing as rapidly as it did formerly. A city gets accustomed to a rate of growth, in which case it may be that a change in the rate of growth is more significant than the rate of growth. Perhaps crime rates may be related to such changes in rates of growth. An approximate measure of such a change is to subtract the rate of growth for the decade 1910–20 from the rate of growth for the decade 1920–30. The correlation of crime rates with increases

in growth rates is for the three groups of cities —.01, —.30, —.53. The Beta coefficients are negative: —, —.36, —.27, even when the increase in wages is held constant.

With regard to the correlation for the large cities an examination of the data show that in Akron, Ohio the difference in the rate of growth between 1910–20 and 1920–30 was —180 while the next largest loss in growth for any city was 25. The data with Akron included hardly lend themselves to the technique used in deriving a coefficient of correlation. With Akron omitted, the correlation becomes —.46 instead of —.01 for the group of large cities. It hardly seems necessary to hold constant the factor of police per unit of population, since no correlation is indicated between change in rate of growth and police. It thus appears that cities with rates of growth that are slowing up have higher crime rates than cities whose rates of growth are increasing.

The interpretation of the conclusion that cities whose growth is slowing up have more crime and those whose growth is increasing have less crime, suggests an economic factor as the cause. It does seem probable that the rate of growth of population is, on the average, related to economic opportunity. The correlations between increase in the rate of growth and increase in wages is +.24, +.18, +20.

The general conclusion on growth is, then, that cities whose rates of growth are increasing have less crime, which is not explained by the number of police, but is probably due to the economic basis of growth.

POPULATION AND LONGITUDE

It is generally known that crime rates are higher in larger cities than in small ones. The following table taken from the "Uniform Crime Reports" for 1933 shows this in figures of the number of offenses known to the police per 100,000 inhabitants:

Population	Murder	Manslaughter by Negligence	Rape	Robbery	Assault	Burglary	Larceny	Auto Theft
250,000....	8.8	6.8	6.5	155.5	52.9	428.1	796.4	423.7
100,000....	7.1	3.7	5.1	70.8	62.2	449.8	899.1	363.7
50,000....	6.2	3.5	5.4	77.8	66.1	354.3	853.9	274.2
25,000....	5.0	2.8	4.8	55.7	41.6	318.6	730.1	201.3
10,000....	4.5	2.6	5.3	42.5	36.3	258.1	589.9	148.0
—10,000....	4.9	2.9	6.8	33.2	25.2	243.3	443.5	93.8

Cities west of the Mississippi have higher crime rates than cities east of it, as is shown by the following table, based upon data for 1931 in "Uniform Crime Reports":

CRIME RATES PER 1,000 BY GEOGRAPHICAL DIVISIONS

Region	Population of Cities by Classes									
	250,000 up		100,000-		50,000-		25,000-		10,000-	
	No.	Rates	No.	Rates	No.	Rates	No.	Rates	No.	Rates
East	15	16	31	16	47	13	81	11	93	9
West	8	20	11	23	13	25	22	21	68	18
South	3	17	7	21	11	18	16	21	27	16
Texas	1	29	3	30	5	17	3	15	7	23

For the small- and middle-sized cities used in this study the crime rate for the Western cities was 12.7 and for those east of the Mississippi 6.5, a difference of 6.2. The calculated rates, based on the regression equations of factors noted on an earlier page, show rates of 10.4 for the Western cities and 7.3 for the Eastern, a difference of 3.1. About half the difference is due to factors not listed in the equations.

CLUSTERS OF INFLUENCES AFFECTING CRIME RATES

The foregoing analysis has been directed to the purpose of isolating and measuring the influence on crime rates of single factors. Disentangling a single factor is not always certain because of the number of factors to which it may be related. However, if one is interested mainly in knowing why crime rates vary from city to city, perhaps clusters of factors not isolated singly may meet the needs.

Of the factors studied there are three more or less separate groups. One is the foreign-born offspring-religion-children cluster with the possible addition of manufacturing. The other is the set of factors indicating economic conditions, while the third is the single factor of the sex ratio, around which there seem to be from our data few other significantly correlated factors.

In regard to the first factor centering around the immigrant, the various factors were all interrelated. The coefficient of correlation between crime rates on the one hand and foreign born, offspring and religion on the other was .58, .52, .47. These in turn are higher than those with the foreign born, young children, and religion: .44, .45, .50. The correlations with crime rates of the foreign born, their offspring and manufacturing were .58, .52, .61. It is clear then that cities with these combinations of factors centering around immigrants have lower crime rates as a result.

With regard to the cluster of economic factors, the correlations of crime rates with increase in wages and with increases in rates of

growth are .50, .32, .60. If rent be considered an economic factor and included, the correlations become .58, .39, .63, quite comparable in size with those of the cluster around immigrants.

The sex ratio factor, it is recalled, is correlated with crime rates to the extent of +.44, +.24, +.55.

The influence of seven of these factors, namely: percent of males, of foreign born, of offspring, rent, increase in wages, change in rate of growth, and church membership, on crime rates has been studied. The multiple correlations are —, .77, .68. This last cluster of seven factors then represents about one-half of the influences that cause the crime rates of cities to vary.

CONCLUSIONS

This study concerned the causes of variations in crime rates among cities. It was limited to measurable factors available for 62 cities, and hence did not include such controlled causes as the courts or corrupt politics. About 25 factors were studied, of which 8 or 10 seemed to have an appreciable influence on the variation in crime rates. In seven of these factors we have accounted for over fifty per-cent of the influences causing crime rates to vary. These seven factors are the percentage of foreign born, the percentage of the offspring of foreign born, the sex ratio, the amount of rent paid, the number of church members, the change in the rate of growth and the change in wages. The influences seem to fall in clusters. Those clustering around the immigrant included their offspring, religion, size of family, and manufacturing. These influences operate to lower crime rates. The economic cluster included changes in rates of growth, changes in wages, and monthly rentals. The higher economic status is associated with lower crime rates. The third was the sex ratio with such factors as those with which it was correlated. The more males in a city, the higher is the crime rate.

Of the various economic factors which are favorable to low crime rates, the increases in the rate of growth of cities in population is of more influence than the index used for increase in wages. The factor represented by rent seems to be less influential, though it may be said that cities with higher rents have lower crime rates.

Cities with larger percentages of immigrants and of the offspring of immigrants in their population have lower crime rates. The data here presented show that lower crime rates are associated more with the offspring of immigrants than with immigrants. Cities with more church members and larger families also have lower crime rates.

THE NATIONAL INCOME AND ITS DISTRIBUTION[1]

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The main purpose of this paper is to discuss certain items in the national income account which have peculiar significance in these times. But I shall first consider in broad outline the major statistical facts about the national income as it has varied recently.[2] I shall make no attempt to bring the most recently published estimates up to date and in general my figures will end with 1932.

In order to have in hand a continuous and substantially homogeneous record covering the post-war cyclical experience and indeed reaching back through the war period, it is necessary to patch together certain available series of estimates. There is some doubt whether such piecing together can satisfactorily provide a continuous series of absolute items, but there is little doubt that the process will yield a sufficiently trustworthy record of the *course* followed by the aggregate. In attempting to work out this piecing process, we shall at once encounter the perplexing difficulties of definition which trouble the analysis of national income at many points. The piecing operation, however satisfactory it may be for describing the course of aggregate national income, would necessarily be less trustworthy for tracing the various shares of the national income and the portions which originate in particular types of industry.

Although there are now several different series of estimates for those years of our period prior to 1930, from among which we might choose in order to carry back the figures published in *National Income, 1929–1932,* I shall restrict my calculations to the series published by Morris A. Copeland.[3] A somewhat different continuation of King's series—replacing King's preliminary 1926–28 items by revised items, and including 1929 items—appears in *America's Capacity to Consume*

[1] The author was assisted, in the research leading to this paper, by a grant of money from the Harvard University Committee on Research in the Social Sciences. This article is the revision of a paper presented at the Ninety-sixth Annual Meeting of the American Statistical Association, December 28, 1934.

[2] *Senate Document*, No. 124, 73rd Cong., 2nd Sess. ("National Income, 1929–32") carries the estimates to 1932. This official study was prepared under the direction of Simon Kuznets. The study announced that the United States Department of Commerce would undertake to carry forward the estimate as new data became available. Although we now have certain figures on the national income which were not available when that study was made, it seems unwise and would probably be impossible with my resources to duplicate the estimate which the Department of Commerce will soon make and publish for 1933.

[3] "How Large Is Our National Income?" *Journal of Political Economy*, XL, December, 1932, page 773. The series is there designated "realized income, revised".

at page 152.[4] The revisions and rearrangements of the King series therein are slight and by no means of the searching sort presented by Copeland. Even so, the main course of the King series as thus carried forward does not differ seriously from that of the Copeland series.

With some reservations, we may say that the Copeland series is more nearly like the series utilized in the recent official publication than any of the others. It is nevertheless not identical with the series of Kuznets.[5] A main distinction between the figures developed by King, and also Copeland, and those of Kuznets is that the latter do

TABLE I

ESTIMATE OF THE ANNUAL AGGREGATE REALIZED INCOME, RELATIVE TO 1929 AS 100, FOR 1910-29 *a*

	Copeland's Figures *b*	Imputed Income *c*	Revised Figures *d*	Relatives to 1929 *e*
1910	31.7	1.9	29.8	34.0
1911	32.2	1.9	30.3	34.6
1912	34.4	2.0	32.4	37.0
1913	36.2	2.1	34.1	38.9
1914	36.2	2.2	34.0	38.8
1915	37.9	2.3	35.6	40.6
1916	44.0	2.4	41.6	47.5
1917	51.9	2.7	49.2	56.2
1918	60.8	3.4	57.4	65.6
1919	65.9	4.0	61.9	70.7
1920	74.2	5.2	69.0	78.7
1921	62.1	4.7	57.4	65.6
1922	65.5	4.3	61.2	69.9
1923	74.4	4.5	69.9	79.8
1924	75.9	4.7	71.2	81.3
1925	80.5	4.8	75.7	86.4
1926	84.7	4.9	79.8	91.1
1927	86.8	5.0	81.8	93.4
1928	89.2	5.1	84.1	96.0
1929	92.9	5.3	87.6	100.0

a. Unit, for first 3 columns, one billion dollars.
b. *Jour. Pol. Econ.*, Dec., 1932, p. 773.
c. *America's Capacity to Consume*, p. 153.
d. Copeland's figures minus imputed income.
e. Calculated from items of third column.

not include "imputed income" yielded by individually-owned urban homes and other durable consumer's goods. I have deducted from the Copeland series the figures for imputed income shown in *America's Capacity to Consume*.[6] Although careful search might enable us to identify, and remove approximately, other elements causing dis-

[4] Maurice Leven, Harold G. Moulton, and Clark Warburton, *America's Capacity to Consume*, (Washington, 1934).

[5] Kuznets, in "National Income, 1929–1932," calls attention to a lack of strict comparableness between his series and that of King. The Copeland series was a revision and refinement of the King series, and therefore the Kuznets compilation is also not strictly comparable with the Copeland series. The official publication announces that the National Bureau of Economic Research is undertaking to carry the Kuznets series back from 1929 and thus replace the King series with a new record, satisfactorily comparable with the most recent items. The result of this operation has not been published and I naturally make no attempt to supply the revision myself.

[6] At page 153. These figures have been used instead of King's, because they rest upon somewhat closer estimates for the last four years.

parity between the Copeland and Kuznets definitions of "realized income" and "income paid out", this does not seem necessary for the present purpose.

Table I gives the published Copeland series, the imputed income items, and my revision of the Copeland series. This revised series is then converted to relatives, on the 1929 item as 100 per cent. There is no occasion to note in this company that the selection of 1929 as a base does not imply that 1929 was normal.

The percentage figures in Table I may be accepted as adequately tracing the course of the realized national income, measured in current dollars, from 1910 to 1929. With this record we may fairly compare the course of "income paid out", expressed in percentages of the 1929 item, since 1929. These percentages,

1929	1930	1931	1932
100.0	92.9	78.0	60.3

are given at page 10 of *National Income, 1929–1932.*

These results suggest that—with price-level changes ignored—the income of 1930 was somewhat above that of 1926, the income of 1931 was somewhat below that of 1923, and the income of 1932 was about the same as that of 1920. Such a description of the course of variation of the national income is of great interest, and is significant for some comparisons. It is clear, however, that most comparisons will be facilitated by using income data in which an allowance has been made for price-level changes. This is particularly important in times when prices change rapidly.

With the broad outline of the recent course of national income—with price-level changes ignored—in mind, we turn to consideration of selected aspects of the income problem. I shall now give chief attention to the disposition of income by corporations. From a theoretical point of view it is of great moment that a highly important share of the aggregate national income is subject to control by officers of corporate enterprises. In saying this, no account is taken of the ordinary disbursements—chiefly in the form of wages and expenditures for materials—made in the course of corporate operations. These expenses also, at least to some extent, are subject to the discretionary control of corporate management. I am concerned rather with those items in the corporate income account which are more fully subject to discretion.

Specifically we are interested in the disposition of corporate profits. This term will be defined for our purposes, as we shall see, in a manner to fit the statistics made available by the income tax. Corporate

profits are disposed of chiefly in two directions: as dividends and as additions to the surplus. The portion which goes into dividends—so far as it finally reaches the hands of individual consumers—is of the highest significance in any adequate consideration of the distribution of the entire national income, as it varies from year to year over the business cycle. The withholding of dividends in times of prosperity and the maintenance, or partial maintenance, of dividends in times of depression tend to stabilize the aggregate income received by individuals. The fact that dividends tend on the average to reach mainly individuals having large incomes rather than those having small incomes, and the fact that dividends constitute a substantial fraction of the total income of large-income recipients, augment the economic and social importance of dividend policies.[7]

That portion of corporate profits which is added to surplus requires special consideration. It may be contended, for example, that rapid increase in surplus during prosperity brings about such excessive increase in the supply of capital goods as is generally characterized by the term "over-capacity". It may be contended also that the cutting down of additions to surplus, and perhaps their conversion into actual deductions, in times of depression may mean that for considerable periods the nation is to some extent living on its capital. These two aspects of the situation must of course be considered together; and, if it may properly be held that an over-capacity of capital equipment developed during prosperity, it may properly be held also that some consumption of capital in depression can go on before the aggregate supply of capital goods falls below normal requirements. Any such superficial statement of the case must be supplemented by various minute considerations which stress the time element and its bearing on obsolescence, the variability of price levels in its bearing on the cost of capital goods, the diversity among lines of industry with respect to the rate at which over-capacity was created and subsequently rectified. Needless to say, there are at present only fragmentary data upon most of these essential supplementary considerations.

Here, as elsewhere in this discussion, we must give attention to matters of definition. For example, we use the term *corporate profits* to mean "compiled net profit less income tax", as tabulated in *Statistics of Income*.[8] This figure clearly differs from that usually designated profits because of the inclusion here of the gains (and losses) from certain capital transactions. Less clear departures from the cus-

[7] Payments of dividends to individuals do, and additions to surplus do not, constitute part of "realized income" or "income paid out".

[8] See page 136 of the issue for 1932. "Compiled net profit" is "total compiled receipts" minus "total statutory deductions".

tomary implications of the term probably arise from more or less well known tendencies for corporations to report income differently for tax than for other purposes. But we can make no allowance for these departures, except for the capital gains (and losses) in certain years; and we accept the "compiled net profit less income tax" as a workable approximation to the net profit available for the owners of corporate equity.

From this figure for corporate profits we deduct "cash dividends paid", and the remainder is the crude figure for the addition to surplus in the given year. (Of course, it may be a negative figure.) For theoretical purposes this crude figure is not entirely satisfactory because, as already noted, the compiled net profit includes net gain from the sale of capital assets. Beginning with the issue of 1929, *Statistics of Income* gives figures for the "profit from the sale of capital assets"; and, beginning with the issue for 1930, figures for the "loss from the sale of capital assets". It is therefore possible to calculate the *net* gain from the sale of capital assets, from 1930 on, by deducting the loss figure from the profit figure. For these most recent years we can correct our crude figures for surplus by the amount of the calculated net gain from the sale of capital assets. After this correction is made the figure for addition to surplus becomes merely the addition arising from ordinary (as against capital) transactions. Before 1930 no such correction is possible. If we want to assume that the loss from the sale of capital assets in 1929 was zero, or that the profit from the sale of assets as given in that year was a net figure, we can indeed carry the correction back through 1929. But no correction whatever is possible before 1929. In order, therefore, to have a homogeneous record covering the last few years, we use the crude surplus figures. Corporate surplus is defined in some of the recent studies of the national income as the crude figure calculated from *Statistics of Income* after deduction for savings of life insurance companies.[9] Before leaving the discussion on capital gains and losses, we note that certain changes in the revenue laws have a bearing on the statistical items presented.

The figures for additions to surplus, for all corporations combined and for each industrial division, appear in Table II A; and corresponding data for each manufacture group appear in Table II B. It must be remembered that these items are in current dollars, and a billion dollars added to surplus in one year has a different physical significance from the same amount in another year in which the price level is different. In speaking of price level in this sense, there is

[9] See for example Leven, Moulton and Warburton, *op cit*, page 152.

TABLE II A

ANNUAL SURPLUS ADDITIONS, FOR ALL CORPORATIONS COMBINED, AND FOR EACH INDUSTRIAL DIVISION *a*

	All Corporations	Manufacture	Trade	Mining	Construction	Agriculture	Service	Public Utilities	Finance
Crude figures—									
1922	1747	1023	307	—153	—1	—23	26	294	270
1923	2528	1413	460	—291	21	9	43	608	246
1924	1575	766	306	—296	46	—27	44	367	367
1925	2957	1338	394	—69	37	—17	55	505	714
1926	2335	1096	236	—98	50	—17	23	572	481
1927	1115	446	174	—273	46	—29	—6	146	618
1928	2479	954	348	—154	33	—17	7	380	931
1929	2320	1378	69	—166	31	—11	15	448	561
1930	—4255	—1736	—630	—305	—31	—64	—80	—608	—788
1931	—7327	—2807	—985	—393	—76	—106	—207	—957	—1781
1932	—8001	—2943	—1037	—306	—132	—97	—477	—1091	—1905
Figures with capital gain excluded—									
1929	1005	1220	12	—215	18	—24	—19	345	—326
1930	—3965	—1681	—601	—337	—21	—63	—82	—597	—2722
1931	—5923	—2604	—885	—381	—56	—100	—165	—893	—833
1932	—6438	—2726	—983	—288	—120	—89	—386	—970	—872

a. Unit: one million dollars. Compiled from *Statistics of Income.*

more than the usual need for care in specification: the perplexing question is as to the use made of the surplus additions.

A further troublesome fact, related to the foregoing, is that the surplus addition is an increment to the existing assets. Unlike that portion of "income produced" which goes into consumption, the addition to surplus must be appraised and understood in connection with the existing stock of assets. This consideration has an important theoretical bearing upon the use, in some of Dr. King's estimates, of market valuation of assets as a basis of measurement of business savings.[10]

These price and valuation difficulties make it sufficiently clear that we can attach little economic significance to the cumulation, over a series of years, of such figures as are shown in Tables II A and II B. Thus, the observations that for all corporations the combined reductions in 1930 and 1931 about offset the combined additions in 1925–29, and that the further reduction of 1932 more than offset the combined additions of 1922–24, are interesting and undoubtedly have certain limited significance. But great caution should be exercised in using such observations as a basis for reasoning about the capital capacity of the nation.

The course of these figures is instructive as revealing the year-to-

[10] Maurice Leven, *Income in the Various States*, (National Bureau of Economic Research), New York, 1925, 27–38.

TABLE II B

ANNUAL SURPLUS ADDITIONS, FOR EACH MANUFACTURE GROUP *a*

	Metals	Foods	Textiles	Chemicals	Paper & Pulp	Lumber	Printing	Stone, Etc.	Leather	Rubber
Crude figures—										
1922	200	100	216	138	19	58	76	55	33	5
1923	578	111	228	22	28	117	58	96	—5	7
1924	346	136	—72	102	29	6	67	66	4	21
1925	707	103	82	155	26	15	54	67	2	83
1926	582	154	—86	280	44	—29	55	45	6	3
1927	210	81	71	2	39	—81	32	30	39	—7
1928	492	150	—22	211	27	—46	87	44	—3	—24
1929	937	117	—45	299	36	—38	66	40	—4	—23
1930	—468	—49	—400	—286	—21	—182	—22	—45	—67	—84
1931	—1060	—154	—365	—541	—56	—214	—66	—94	—65	—47
1932	—1266	—200	—343	—343	—85	—220	—101	—124	—64	—51
Figures with capital gain excluded—										
1929	881	99	—52	276	26	—56	58	26	—5	—24
1930	—433	—25	—388	—336	—19	—180	—15	—41	—66	—83
1931	—975	—116	—335	—535	—53	—214	—54	—90	—62	—44
1932	—1207	—138	—317	—317	—82	—208	—93	—116	—68	—49

a. Unit: one million dollars. Compiled from *Statistics of Income.*

TABLE III

DEPRECIATION AND DEPLETION, FOR ALL CORPORATIONS, THE MINING DIVISION, AND THE CHEMICALS GROUP *a*

	All corporations			Mining			Chemicals		
	Depreciation	Depletion	Both combined	Depreciation	Depletion	Both combined	Depreciation	Depletion	Both combined
1922	——	——	2889	——	——	550	——	——	303
1923	——	——	3116	——	——	666	——	——	291
1924	——	——	3187	——	——	651	——	——	247
1925	2858	472	3330	280	281	562	244	63	307
1926	3270	571	3841	233	275	508	330	155	486
1927	3346	502	3848	231	231	461	366	147	513
1928	3597	516	4112	207	212	419	391	156	547
1929	3871	559	4430	228	243	471	416	172	589
1930	3986	463	4449	194	183	377	461	165	626
1931	4002	268	4270	194	108	303	444	84	528
1932	3693	246	3940	166	102	267	419	90	509

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cumulation over the entire period of prosperity.

The enormous reductions in surplus in 1930–32—and they were probably even greater in physical terms, as the level of prices in those years was much below that prevailing in 1922–29—clearly suggest that any excess capacity *developed* in 1922–29 must have been more than cancelled by 1932. This takes no account of the possible diversities among lines of industry: to a consideration of those we now turn.

Consideration of Tables II A and II B shows that, despite some similarities between the experience of particular divisions or groups and that of all corporations combined, there are some striking diversi-

profits are disposed of chiefly in two directions: as dividends and as additions to the surplus. The portion which goes into dividends—so far as it finally reaches the hands of individual consumers—is of the highest significance in any adequate consideration of the distribution of the entire national income, as it varies from year to year over the business cycle. The withholding of dividends in times of prosperity and the maintenance, or partial maintenance, of dividends in times of depression tend to stabilize the aggregate income received by individuals. The fact that dividends tend on the average to reach mainly individuals having large incomes rather than those having small incomes, and the fact that dividends constitute a substantial fraction of the total income of large-income recipients, augment the economic and social importance of dividend policies.[7]

That portion of corporate profits which is added to surplus requires special consideration. It may be contended, for example, that rapid increase in surplus during prosperity brings about such excessive increase in the supply of capital goods as is generally characterized by the term "over-capacity". It may be contended also that the cutting down of additions to surplus, and perhaps their conversion into actual deductions, in times of depression may mean that for considerable periods the nation is to some extent living on its capital. These two aspects of the situation must of course be considered together; and, if it may properly be held that an over-capacity of capital equipment developed during prosperity, it may properly be held also that some consumption of capital in depression can go on before the aggregate supply of capital goods falls below normal requirements. Any such superficial statement of the case must be supplemented by various minute considerations which stress the time element and its bearing on obsolescence, the variability of price levels in its bearing on the cost of capital goods, the diversity among lines of industry with respect to the rate at which over-capacity was created and subsequently rectified. Needless to say, there are at present only fragmentary data upon most of these essential supplementary considerations.

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TABLE II A

ANNUAL SURPLUS ADDITIONS, FOR ALL CORPORATIONS COMBINED, AND FOR EACH INDUSTRIAL DIVISION *a*

	All Corporations	Manufacture	Trade	Mining	Construction	Agriculture	Service	Public Utilities	Finance
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1923	2528	1413	460	—291	21	9	43	608	246
1924	1575	766	306	—296	46	—27	44	367	367
1925	2957	1338	394	—69	37	—17	55	505	714
1926	2335	1096	236	—98	50	—17	23	572	481
1927	1115	446	174	—273	46	—29	—6	146	618
1928	2479	954	348	—154	33	—17	7	380	931
1929	2320	1378	69	—166	31	—11	15	448	561
1930	—4255	—1736	—630	—305	—31	—64	—80	—608	—788
1931	—7327	—2807	—985	—393	—76	—106	—207	—957	—1781
1932	—8001	—2943	—1037	—306	—132	—97	—477	—1091	—1905
Figures with capital gain excluded—									
1929	1005	1220	12	—215	18	—24	—19	345	—326
1930	—3965	—1681	—601	—337	—21	—63	—82	—597	—2722
1931	—5923	—2604	—885	—381	—56	—100	—165	—893	—833
1932	—6438	—2726	—983	—288	—120	—89	—386	—970	—872

a. Unit: one million dollars. Compiled from *Statistics of Income*.

more than the usual need for care in specification: the perplexing question is as to the use made of the surplus additions.

A further troublesome fact, related to the foregoing, is that the surplus addition is an increment to the existing assets. Unlike that portion of "income produced" which goes into consumption, the addition to surplus must be appraised and understood in connection with the existing stock of assets. This consideration has an important theoretical bearing upon the use, in some of Dr. King's estimates, of market valuation of assets as a basis of measurement of business savings.[10]

These price and valuation difficulties make it sufficiently clear that we can attach little economic significance to the cumulation, over a series of years, of such figures as are shown in Tables II A and II B. Thus, the observations that for all corporations the combined reductions in 1930 and 1931 about offset the combined additions in 1925–29, and that the further reduction of 1932 more than offset the combined additions of 1922–24, are interesting and undoubtedly have certain limited significance. But great caution should be exercised in using such observations as a basis for reasoning about the capital capacity of the nation.

The course of these figures is instructive as revealing the year-to-

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TABLE III

DEPRECIATION AND DEPLETION, FOR ALL CORPORATIONS, THE MINING DIVISION, AND THE CHEMICALS GROUP[a]

	All corporations			Mining			Chemicals		
	Depreciation	Depletion	Both combined	Depreciation	Depletion	Both combined	Depreciation	Depletion	Both combined
1922	——	——	2889	——	——	550	——	——	303
1923	——	——	3116	——	——	666	——	——	291
1924	——	——	3187	——	——	651	——	——	247
1925	2858	472	3330	280	281	562	244	63	307
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1927	3346	502	3848	231	231	461	366	147	513
1928	3597	516	4112	207	212	419	391	156	547
1929	3871	559	4430	228	243	471	416	172	589
1930	3986	463	4449	194	183	377	461	165	626
1931	4002	268	4270	194	108	303	444	84	528
1932	3693	246	3940	166	102	267	419	90	509

a. Unit: one million dollars. Compiled from *Statistics of Income.*

TABLE II B

ANNUAL SURPLUS ADDITIONS, FOR EACH MANUFACTURE GROUP *a*

	Metals	Foods	Textiles	Chemicals	Paper & Pulp	Lumber	Printing	Stone, Etc.	Leather	Rubber
Crude figures—										
1922	200	100	216	138	19	58	76	55	33	5
1923	578	111	228	22	28	117	58	96	—5	7
1924	346	136	—72	102	29	6	67	66	4	21
1925	707	103	82	155	26	15	54	67	2	83
1926	582	154	—86	280	44	—29	55	45	6	3
1927	210	81	71	2	39	—81	32	30	39	—7
1928	492	150	—22	211	27	—46	87	44	—3	—24
1929	937	117	—45	299	36	—38	66	40	—4	—23
1930	—468	—49	—400	—286	—21	—182	—22	—45	—67	—84
1931	—1060	—154	—365	—541	—56	—214	—66	—94	—65	—47
1932	—1266	—200	—343	—343	—85	—220	—101	—124	—64	—51
Figures with capital gain excluded—										
1929	881	99	—52	276	26	—56	58	26	—5	—24
1930	—433	—25	—388	—336	—19	—180	—15	—41	—66	—83
1931	—975	—116	—335	—535	—53	—214	—54	—90	—62	—44
1932	—1207	—138	—317	—317	—82	—208	—93	—116	—68	—49

a. Unit: one million dollars. Compiled from *Statistics of Income.*

year experience of corporate industry and its several divisions. The record for all corporations combined—the first column of Table II A—reveals emphatically the roughly horizontal course of the surplus addition during the long period of sustained general prosperity, 1922–29, and the violent reduction to negative levels during the depression. Significant minor variations in the long cycle are also reflected: the recession of 1924, and that of 1927. The failure of the surplus addition to rise substantially from 1922 to 1929—and, as this was a period of fairly stable prices, the same condition held approximately for physical additions to surplus—strongly suggests that the alleged development of over-capacity was not a characteristic of the final years of prosperity. If it existed at all, it resulted from a cumulation over the entire period of prosperity.

The enormous reductions in surplus in 1930–32—and they were probably even greater in physical terms, as the level of prices in those years was much below that prevailing in 1922–29—clearly suggest that any excess capacity *developed* in 1922–29 must have been more than cancelled by 1932. This takes no account of the possible diversities among lines of industry: to a consideration of those we now turn.

Consideration of Tables II A and II B shows that, despite some similarities between the experience of particular divisions or groups and that of all corporations combined, there are some striking diversi-

ties. Among these, the record for mining is particularly interesting: there was no positive surplus addition in any year, but the deductions from surplus during the depression were only moderately greater than those during prosperity. It is here that charges for depreciation and depletion require special attention—these items combined are of relatively greater importance for mining than for any other division, and the only other class for which they are of large significance is the chemicals group. Table III shows the record for depreciation and

TABLE ~~III~~ IV

NET DIVIDEND PAYMENTS BY ALL CORPORATIONS, AND BY INDUSTRIAL DIVISIONS AND MANUFACTURE GROUPS *a*

	All Corporations	Manufacture	Trade	Mining	Construction	Agriculture	Service	Public Utilities	Finance
1922...	2634	1308	302	139	33	24	49	399	366
1923...	3299	1761	369	223	40	24	68	407	404
1924...	3424	1651	390	213	34	24	71	609	428
1925...	4014	1908	440	269	61	27	92	673	541
1926...	4439	2117	471	327	43	25	105	829	518
1927...	4766	2226	495	278	50	39	107	1060	510
1928...	5157	2507	499	253	54	41	99	1072	632
1929...	5763	2575	566	365	64	25	117	1261	791
1930...	5631	2613	497	249	88	15	113	1484	571
1931...	4182	1894	386	138	42	20	74	1182	446
1932...	2626	1116	214	82	23	8	54	884	246

	Metals	Foods	Textiles	Chemicals	Paper & Pulp	Lumber	Printing	Stone, Etc.	Leather	Rubber
1922.....	366	154	189	214	35	82	67	41	22	11
1923.....	543	224	211	267	57	118	68	58	35	15
1924.....	622	249	174	244	37	96	64	63	29	15
1925.....	667	279	178	319	61	110	88	76	38	11
1926.....	83	274	177	346	48	114	97	96	32	5
1927.....	900	329	184	331	57	99	110	82	27	50
1928.....	989	344	187	495	65	104	99	80	45	18
1929.....	982	402	179	486	57	93	133	87	37	34
1930.....	987	434	131	600	52	64	128	76	38	32
1931.....	651	367	98	460	37	30	95	54	28	22
1932.....	303	292	55	280	21	14	60	28	20	14

a. Unit: one million dollars. Compiled from *Statistics of Income*.

depletion, separately and combined, for all corporations, for the mining division, and for the chemicals group. In the case of mining, there is some reason to believe that the charges may have been unduly large during the late prosperity stage or unduly small during depression—if we make a rough adjustment on this basis, the surplus addition for mining would follow a course less widely different from that for all corporations.[11] Whether the charges made for depreciation

[11] Morris A. Copeland, "Some problems in the theory of national income" in *Journal of Political Economy*, XL, February, 1932, pp. 12–17, has discussed the perplexing problems raised by the mining data at length and from another point of view.

were currently offset, at least approximately, by expenditures chargeable to depreciation reserves bears upon the analysis of the demand for capital goods, discussed briefly below.

We have found, in Tables II A and II B, some evidence of uniformity in experience with reference to surplus accumulation; but the extent of the diversity among lines of industry is the really striking feature of the record. Manufacture as a whole appears to have an experience closely similar to that for all corporations; but, when we break the great manufacture division into groups, diversity is at once revealed. We may fairly expect that breaking the other large divisions, such as trade and public utilities, into groups would reveal diversity. It is also probable that sub-classifying the large manufacture groups, such as foods and metals, would disclose diversities. The statistics are already in sufficient detail to confirm the reasonable *a priori* inference that surplus accumulation since the war has not been a uniformly characteristic experience in all lines of industry, and more detailed statistics would almost surely add stronger confirmation.

The tax statistics give no satisfactory answer to an important question alluded to in our discussion of depreciation: what use is made of these funds? Just as we do not definitely know what charges are currently made against the depreciation reserves, we have no sure knowledge as to the form of assets "added" by the accumulation of surplus. If we might assume that *all* the surplus addition went into capital plant and equipment, use of a roughly appropriate price index as a deflator might yield an approximate measure of the resultant changes in physical capacity. But the possibility—indeed, the probability—that important shares of the surplus addition go into cash and inventories and other current assets greatly complicates the analysis.

A helpful approach to this question of the supply of capital goods is made from another angle in "Gross capital formation, 1919–33" by Kuznets.[12] It there appears that wide variations occurred in the additions to equipment and plant—both in value and in amount—and that business inventories constituted a reservoir from which actual drafts were made in years of depression or severe recession. There can still be question as to what rate of capital formation was "normal"; but there can be no question that, about any reasonably appropriate normal line, there were wide fluctuations in the annual accretions. These correspond generally in direction, though not in

[12] *Bulletin* 52, November, 1934, National Bureau of Economic Research, especially Table 5, p. 6.

amount, to the variations in surplus accumulation. The analysis developed by Kuznets is not yet available on a basis which classifies by type of industry, and we are thus unable to carry out the comparison in detail.

We turn now to a brief consideration of the other disposition made of corporate surplus—dividend payments. With reference to dividends paid there is no difficulty in statistical definition, but we encounter difficulty in interpreting the reported statistics in our analysis of the effect of the distribution of dividends among individuals. The essential point involved is that an important share of corporate dividends go to other corporate groups. When we consider the corporate structure as a whole it is simple, however, to deduct dividends received by corporations from dividends paid by corporations (both figures are given in *Statistics of Income*); and the residue comprises those dividends which go to individuals or to unincorporated concerns. But when we turn to specific groups of corporations, for example, the manufacturing group, a different problem arises. The dividends paid out by manufacturing corporations go in three directions: to other manufacturing corporations, to corporations other than manufacturing corporations, and to individuals and unincorporated units. If we deduct from dividends paid by manufacturing corporations the dividends received by manufacturing corporations, we completely offset the first of these three parts, but we do not completely offset the second. We may not, therefore, say that the residue goes entirely to the third part, that is, to individuals. In other words, a portion of the net dividends paid out by manufacturing corporations may go to other corporations—in fact, the "residue" might be negative, indicating that the particular group received more dividends than it paid out.

With corporate profit defined as we have used it, it is total dividends paid—and not the net dividends paid—which must be deducted from corporate profit to arrive at the surplus addition. But, from the point of view of corporate policy in disbursing dividends, it is well to think of net dividends. From this point of view dividends received by corporations are merely passed along as dividends paid; and, although policy might withhold all or a part of this dividend income, it is less likely to do so than in the case of other income. The net figure also more nearly shows the contribution made by the corporate group to individual incomes than does the figure for gross dividend payments. In order to show the record of changes in net dividend payments, as a reflection of corporate policy, we present the 1922–32 data in Table IV. It is clear from this record, that considerable

stability characterized dividend policies of most groups, except at the extremes of the cycle.

We have examined the course of annual surplus additions, for corporate enterprise as a whole and for various groups of corporations, and we have noted striking diversity among the groups. The general record is one of roughly constant moderate surplus additions during prosperity, followed by heavy deductions from surplus during deep depression. With due allowance for price changes it may be inferred that, so far as changes in surplus appear in changes in capacity of plant and equipment, three years of depression more than offset the accumulation of eight years of prosperity.

The crude figures for surplus addition include net gain (or loss) from the sale of capital assets. If we could correct the crude figures for this factor, we should find somewhat smaller surplus additions in the late years of prosperity and somewhat smaller surplus reductions during depression—the main outlines of the record would not be changed. We should still have abundant reason for believing that, unless new supplies of capital were made available during depression through non-corporate savings and investment, the capital assets under corporate control were impaired in depression fully as much as they were extended in prosperity. Important new data on the production of durable capital goods tend to confirm this view.

To an important degree, the amount carried to surplus in any one year is dependent upon the dividend payments (gross); and the maintenance of dividends, at least in part, contributed to the size of the surplus reductions during depression. In so far as the policy of maintaining dividends is followed as a means of distributing income to consumers, it is well to remember that a very large share of dividend payments (net) go to individuals having incomes of over $5,000 a year. An important portion of dividends received by such individuals is saved and is returned to restore the volume of corporate assets. Such individuals undoubtedly do use their dividends in some measure to maintain consumption, and dividends going to individuals with incomes below $5,000 probably contribute more largely to consumption. But it is clear that the effect of the payment of dividends upon consumption is limited; and the limitation is the greater when we are considering a restricted group of corporations, for which a portion of net dividend payments may go to other corporation groups.

We conclude that the policy of maintaining dividends in depression cannot stimulate the demand for consumption goods to an extent suggested by the crude data on net dividend payments. It appears also that, because of the uncertain relation between dividend payments

of corporations and the savings of individuals, the surplus-addition figures give no trustworthy indication of the extent of capital accumulation or impairment. That some consumption of capital has occurred in depression is unmistakable, but that it has offset the post-war accumulation is not clear.

A GENERAL-PURPOSE CLASSIFICATION FOR MANUFACTURING INDUSTRIES[1]

By Ralph C. Epstein, *University of Buffalo*

I

The problem of classifying business enterprises by industries or trades confronts all government departments that collect information concerning output, workers, earnings, and similar statistical data. Each department necessarily collects its data in different ways, and since the statistical requirements of departments differ, different industrial classifications have inevitably developed. In consequence, the data published by such agencies as the Census, the Bureau of Internal Revenue, the Bureau of Labor Statistics, while valuable for many purposes, are of limited usefulness in other directions, particularly because they are to a large extent noncomparable.

Much of the present discussion is applicable, in principle, to all branches of trade and commerce, but in the main it will be limited to manufacturing industry. Both in themselves and in relation to manufacturing, however, the other industrial divisions, particularly mining, construction, and trade, require much the same kinds of analysis as are here suggested for the manufacturing division.

The significance of having statistical data so classified as to permit their legitimate comparison may be illustrated by citing a few of the problems on which such comparisons would throw light. In studies of productive capacity, for example, the investigator needs to know if the investment of capital in plant facilities is proceeding more rapidly, less rapidly, or at the same rate as the growth of the market for the specific sets of goods which such plants produce. Here output data and capital-investment data need to be related. In studies of industrial mechanization, it would help to be able to compare the growth of capital assets, total assets, output, and man-hours. In any adequate studies of industry's ability to pay certain wage rates, it is desirable to have data for other costs as well as wages, for sales volume, and for profits. Such data, it almost goes without saying, need to be closely comparable for *particular industries* and for different classes of *enterprise* within these industries.

In all studies of "purchasing power," furthermore, it is important to have comparable data by specific industries. Only figures that

[1] Summary of a part of a report on classification of manufacturing industries prepared for the Committee on Government Statistics and Information Services. The writer desires to acknowledge the helpful collaboration of Mildred L. Hartsough and Ernestine Wilke in connection with several sections of the report.

relate to the same sets of corporations, classified by the same industrial groups for all series, and broken down by specific types of industrial activity, can yield trustworthy results.

II

Superficially, and in broad terms, the classifications of manufacturing industry employed by the Bureaus of the Census, Internal Revenue, and Labor Statistics do not appear to differ greatly. The major groups of industries, such as Foods, Textiles, etc., are very similar for the three bureaus. In subgroups or specific industries, on the other hand, the detail shown by the two classifications differs enormously. The Bureau of Internal Revenue shows certain income figures for 44 manufacturing subgroups but shows balance-sheet figures for only the 12 major groups. The Census of Manufactures, on the other hand, gives all its principal data by more than 300 subgroups or industries. The Revenue Bureau has not attempted so great a breakdown because its data pertain to corporations rather than to either establishments or commodities and because it is impossible to break down the profit and investment figures for a given corporation in any satisfactory way.

The difficulty of classifying corporate returns by individual industries or manufacturing subgroups is now, however, greatly mitigated by the Revenue Act of 1934, which no longer permits the filing of consolidated returns by different corporations under the same ownership. It is thus physically possible for the Bureau of Internal Revenue to elaborate its subdivisions of industrial groups, with fruitful consequences.[2] Even before the consolidated return was abolished, the Joint Committee on Income Tax Statistics recommended that some elaboration be essayed. In spite of the difficulties involved, the effort now clearly appears worth making.

Were such breakdowns made in *Statistics of Income* (in its balance sheet as well as in its income-account figures), the Census of Manufactures could then combine some of its numerous chemical classifications so as to correspond with the several new—and more highly elaborated—groupings developed by the Bureau of Internal Revenue.

For such data to be comparable, however, the Census would have to present them by *enterprises* instead of by commodities. This would do some violence to the Census tradition of tabulation on the

[2] "Physically" in the sense of "mechanically," and in contrast with "financially." The budgetary aspects of the several proposals of this memorandum will be discussed in a later section.

basis of process and product, or upon the basis of "establishment," instead of business enterprise. To be sure, the traditional split-up of the output of an enterprise by *commodities* is absolutely necessary for important statistical purposes that census data have always served. On the other hand, for other types of problems and analysis, for comparative studies of relations between aggregate output, profits, capital investment, employment, payrolls, and other items, data seem clearly needed by *enterprises;* for decisions as to employment, investment, and even commodity production itself are in the last analysis made by enterprises, i.e., corporations or other units.

III

The basic discrepancies between governmental classification practices, which go far deeper than surface comparisons of captions and subcaptions, rest chiefly upon the fact that numerous business enterprises carry on more than one type of manufacturing or other activity. The assignment of an enterprise, or even an establishment, to any given industrial category must necessarily be arbitrary. In some instances the degree of resultant distortion is large, in others extremely small.

In large measure, the present fundamental discrepancies between the classifications of the Census Bureau and the Bureau of Internal Revenue are caused by the assignment *of the same establishments and enterprises to different industrial groups.* This is borne out by a comparison of the sales and value of product figures for manufacturing corporations shown respectively in the Bureau of Internal Revenue's *Statistics of Income* and in the Census of Manufactures. While the former takes the corporation as the unit and the latter the establishment, both agencies assign the unit to an industrial group on the basis of its product or products of chief value. Taking broad totals by major groups of industries and by industrial divisions, therefore, one would expect the Census value of product figures and the *Statistics of Income* sales figures to agree. Do they?

Since the Census figures for 210,959 *corporate owned* establishments are shown for 326 separate industries, and not combined into major groups, we have assembled these figures into data for the 11 major manufacturing groups shown in *Statistics of Income,* omitting such census industries as are not formally classified as manufacturing in *Statistics of Income.*

The aggregate 1929 Census figure for all manufacturing (exclusive of industries classified as nonmanufacturing by the Bureau of In-

ternal Revenue) is 63 billion dollars;[3] the *Statistics of Income* figure, 69 billions. Examining the major group figures in detail, however, we find that figures for some groups correspond very closely: the two Textile figures, for example, are almost exactly 8 billions; the Leather figures 1.7 billions each. For other groups, however, they are very far apart, the largest discrepancies being in Foods (where the Internal Revenue figure exceeds that of the Census by 2.59 billions) and in Chemicals (the Internal Revenue figure being larger by 2.19 billions).

If the Food group is investigated more closely, it is found that the census value of products for the subgroup Meat Packing (wholesale) is 3.3 billions, whereas the *Statistics of Income* figure for the gross income of the Packing House Products group (no sales data are given in *Statistics of Income* for specific industries) is 5.4 billions. Because of the consolidated income-tax return, much activity that the Census fails to list as Food Manufacturing must find its way into the *Statistics of Income* figures for that group. Similar examination of the Chemicals figure indicates that in the *Statistics of Income* figures for Petroleum Refining much extractive rather than manufacturing activity is represented.

Even with the figures for Meat Packing and Petroleum Refining omitted from both sets of figures, the discrepancies that remain are still so substantial that it would be a dangerous procedure to compare census figures on, say, employment or payrolls with *Statistics of Income* figures on profits or expenses in particular groups.

A partial explanation of the failure of the Census of Manufactures figures for value of product to equal Internal Revenue sales figures lies in the fact that the number of manufacturing corporations covered by the Census is smaller than that reporting to the Bureau of Internal Revenue.

Comparison of the number of corporations reporting manufacturing operations to the Census with those enumerated in *Statistics of Income* indicates a discrepancy of several thousand. This is doubtless to be explained partially as incomplete coverage by the Census; even more significant, perhaps, is the fact that, while all corporations must file income-tax returns, the Census obtains reports only from those in which the value of product is $5,000 or over. The statistical section of the Bureau of Internal Revenue, at the request of the writer, made a "run" of the punchcards for 1932 for about 63,000

[3] That is, for all manufacturing carried on by corporations. Unincorporated establishments, according to the Census of Manufactures, showed a value of product figure of 5½ billions in the same year (1929).

corporate income-tax returns (manufacturing), comprising the concerns that reported deficits in that year. Of these 63,000, approximately 8,700 showed sales of under $5,000 each.

This is indeed a surprising result. What figure would prevail in a year less abnormal than 1932 cannot be guessed. Beyond question the sales of most of these corporations were larger in 1929 than in 1932, but no basis exists for estimating the number with sales under $5,000 in the earlier year.

Very probably, therefore, the discrepancy between the Census and the *Statistics of Income* figures for the number of manufacturing corporations rests upon three principal grounds: (1) classification discrepancies, (2) exclusion by the Census of establishments with sales of under $5,000, (3) failure of Census to cover all corporations with sales somewhat above $5,000.[4]

That the figures now published by the several government departments are, in spite of the discrepancies here indicated, often utilized in comparative studies only emphasizes the need for really comparable data.

IV

It is probably impossible to work out a detailed industrial classification that would be uniform for all government departments. But it is entirely conceivable that a sufficiently detailed grouping could be developed for general purposes, and that the several government departments might publish this parallel with their own industrial classifications that have been developed over a period of years for particular purposes.

An illustrative classification for manufacturing has been worked out by the author. It divides manufacturing into 73 specific industries, arranged in 14 groups.[5] For some purposes, such a breakdown is not sufficiently detailed. But it serves many purposes of analysis fairly well—far better than some more abbreviated classifications now in use, and better from some points of view than would

[4] It should be noted that the Census exclusion is of "establishments" with output of under $5,000. In the case of a central-office corporation having two establishments, nearly $10,000 of product might conceivably be thus excluded. But it is unlikely that many combinations would possess establishments this small.

[5] Details appear in the complete report. That the number of industries (73) is the same as developed in the classification utilized by the author in his profits studies for the National Bureau of Economic Research is largely coincidental. Of course, the classification developed in the Committee on Government Statistics work bears some relation to the other study. Anyone who endeavors to classify manufacturing activities necessarily obtains more than a given number (something over 50 or 60) of organic groups. The point is merely that the two classifications in question are not the same, although the number of groups happens to be 73 in both cases.

a more detailed grouping of products and processes based on extensive breakdowns of commodity production.

The assignments to the one or the other category of this proposed classification are to be made on the basis of enterprise, rather than of commodity or establishment. Only in this way can comparability of output, wage, employment, income, and investment statistics be achieved. This, it may be reiterated, is not to deny the value of "purer," establishment data. Such data are clearly needed. But if a standard government classification of business activities were adopted by several departments, it ought, for reasons already given, to rest upon the more realistic basis of enterprise.

The problem of assigning enterprises to the one or the other industry here needs to be very carefully approached. The classification suggested is illustrative rather than final; experimental work with census schedules, on the basis of enterprises, would provide a basis for the formulation of the least unsatisfactory classification.

In any standard government classification, it would be necessary for the several agencies to agree on certain basic rules to govern the assignment of enterprises. The following are some of the questions involved:

1. On what basis should an enterprise be assigned to an industry? At present, allocation is on the basis of 50 percent or more of the product. Should that requirement be changed, and if so, how?
2. Should classification be shifted in succeeding years if the proportional importance of the products shifts?
3. If not, for how long a time should logical consistency be sacrificed in the interests of statistical comparability?
4. Can the enterprises in which predominant importance of one product is not clear be placed in miscellaneous categories, or can their total product be shown in a separate category with cross references to both classifications affected?
5. Should two categories be made, one containing the clear-cut, relatively "pure" cases, the other the more unsatisfactory, "impure" cases?

It is easier to ask these questions than to answer them. Just what criteria, however, are used is not so important as (a) that provision be made to segregate the few egregious cases when inclusion would distort group figures, and (b) that the several departments employ the same criteria and assign the same enterprises to groups that bear common labels.[6]

[6] Value of product, it should be noted, is not always the best criterion upon which to base such assignments; but "value added" is not available, by classes of products, in the census schedules.

V

The basis on which classification of industrial activity, products, and processes can conceivably be undertaken are many: raw materials; types of manufacturing processes; ultimate purpose, *i.e.*, whether consumers' or producers' goods; the character of the replacement demand for the product, *i.e.*, whether it is durable or nondurable, etc. But no one of these bases has been consistently applied, and experts like E. Dana Durand have suggested the difficulty, if not the impossibility, of a rigorously and consistently logical classification. Thus most classifications represent compromises between, or combinations of, these principles. (A tabular analysis, prepared by Dr. Durand, of several broad classification schemes appears in Tables I and II).

TABLE I

COMPARISON OF EPSTEIN'S GROUPS WITH GROUPS OF BUREAU OF FOREIGN AND DOMESTIC COMMERCE AND OF CENSUS

(PREPARED BY E. DANA DURAND)

Epstein classification of industries	Bureau of Foreign and Domestic Commerce classification of exports and imports	Census groups
I. Foods	00. Animal Foods	I. Food
II. Textiles	0. Other animal products Leather and shoes Furs Miscellaneous	II. Textiles
III. Leather		III. Forest products except paper
IV. Rubber	1. Vegetable food products	IV. Paper
V. Lumber	2. Vegetable products, n.e.s. Rubber Vegetable oils Tobacco Other	V. Printing and publishing
VI. Paper		VI. Chemicals (incl. explosives and oils)
VII. Printing and publishing	3. Textiles	VII. Petroleum and coal
VIII. Chemicals	4. A. Wood B. Paper (not printed matter)	VIII. Rubber
IX. Stone, clay and glass	5. A. Coal and petroleum B. Other nonmetallic minerals	IX. Leather
X. Metals A. Machinery B. Other	6. Metals and manufactures except machinery and vehicles (incl. firearms)	X. Stone, clay and glass
XI. Transportation equipment	7. A. Machinery B. Vehicles	XI. Iron and steel except machinery and vehicles (incl. firearms)
XII. Petroleum and coal products	8. Chemicals (incl. explosives)	XII. Nonferrous metals (including watches and clocks, and jewelry)
XIII. Tobacco	9. Miscellaneous (including printed matter, watches and clocks, and firearms)	XIII. Machinery
XIV. Miscellaneous		XIV. Transportation equipment
		XV. Railroad shops
		XVI. Miscellaneous (including fur goods)

The author's scheme is similarly electic, but it aims to permit rearrangements on the part of the user that enable some measure of grouping according to one or another of the general principles. Foods,

TABLE II

GROUPS FOR CLASSIFICATION OF COMMODITIES

(PREPARED BY E. DANA DURAND)

A. Epstein's groups	B. Committee of Statistical Experts' groups *	C. Suggested grouping combining A and B
I. Foods	I. Food	I. Food (? including all or part of oils and fats)
II. Textiles	II. Tobacco	II. Tobacco
1–5. Clothing	III. Oils and fats	III. Chemicals (? including all or part of oils and fats)
6–11. Cloths, etc.	IV. Chemicals	IV. Rubber
12. Made-up textile articles.	V. Rubber	V. Wood. Cork
III. Leather (incl. shoes)	VI. Wood. Cork	VI. Paper
IV. Rubber	VII. Paper	VII. Leather, excluding shoes
V. Lumber	VIII. Leather, excluding shoes	VIII. Textiles (Epstein 6–11)
VI. Paper	IX. Textiles	IX. Clothing (incl. hats and shoes) and made-up textiles (Epstein 1–5, 12)
VII. Printing	X. Clothing (incl. hats and shoes) and made-up textiles	X. Coal and Petroleum
VIII. Chemicals	XI. Nonmetallic minerals, (incl. coal and petroleum)	XI. Other nonmetallic minerals
IX. Stone, clay and glass	XII. Precious metals and stones (mostly not mfrs.)	XII. Base metals (Epstein 9–10, 12–15)
X. Metals	XIII. Base metals	XIII. Machinery (Epstein X: 1–8, 11)
1–8. Machinery	XIV. Machinery and vehicles	XIV. Transportation equipment
9–15. Other (11, machine shops)	XV. Miscellaneous *crude* animal and vegetable products (not mfrs.)	XV. Printing
XI. Transportation equipment	XVI. Miscellaneous manufactured articles, including printing	XVI. Miscellaneous
XII. Petroleum and coal products		
XIII. Tobacco		
XIV. Miscellaneous		

* Committee of Statistical Experts of the International Convention Concerning Economic Statistics; this classification is intended primarily for classifying commodities in foreign trade.

for example, are segregated—here *use* is the basis. The textile group rests upon *materials* as a base. But clothing industries—*use* again—can be segregated from other textiles. Metals in one general group rest upon a basis of materials. But a combination of motor vehicles and railroad cars gives vehicles for land transportation—again *use*. Within the metals group, some distinctions on the basis of *stage* of production are observed. In general, in most groups, predominantly producers' may be distinguished from predominantly consumers' goods, durable from perishable goods, and manufacturing activities that supply the construction industry from those that do not.

The Census foundry and machine-shop products group is broken down into several machinery groups that are not shown as separate industries by the Census. These machinery groups are followed by a subtotal for all machinery, excluding household equipment. Provision is then made separately for foundry and machine-shop enterprises in which the predominant products are not finished machinery. Whether or not the diversity of activity in the foundry and machine-shop industry as now classified by the Census is too great to permit

the separations here proposed is uncertain; this is one of the numerous questions on which experimental studies ought to throw light. Additional breakdowns of this sort would, of course, assist further in attaining the classification's "general-purpose" objective, but administrative and budgetary obstacles seem to make it unwise to go much further in elaborating categories.

VI

Were a standard classification adopted by the several departments, the next important question arising would be that of the coverage of the data tabulated. In any common classification of manufacturing industries such as has been suggested, the three principal agencies involved are the Bureau of the Census, the Bureau of Internal Revenue, and the Bureau of Labor Statistics. In general it can be said that the first collects data for all establishments, incorporated or otherwise (with an output of over $5,000); the second, only for corporate enterprises, but for all of them; the third, for both incorporated and unincorporated enterprises, but for only a sample of each class. Thus, if all the industrial data gathered by each agency were tabulated, even though in accordance with a standard classification, the results would not be so directly comparable as if the coverage of enterprises were identical.

How much would be sacrificed if the Census—for purposes of the supplementary standard classification—included only corporate enterprises? In the aggregate, about 5.5 billion dollars of value of product would not be shown; this is about 8 percent of the 70.4 billion census total for incorporated and unincorporated manufacturing enterprises combined. About half of the total number of establishments, however, would not appear in the tabulated figures.

More important, as a measure of the significance of corporate enterprise for most analytical purposes, are circumstances in particular industries. In each of nearly 200 of the 326 census industries, corporate activity (measured by sales volume of value of product) represented 90 percent or more of total volume. In 250 industries, it represented 80 percent or more. In only 19 of the industries for which the calculation could be made was the figure less than 60 percent.[7]

[7] Figures could not be computed for 17 industries because the number of enterprises was too small to permit the Census to segregate the corporate data.

The complete summary is as follows:

Percent of total value of product, establishments owned by corporations	Number of industries	Cumulative
90–100	196	196
80 and under 90	54	250
70 and under 80	25	275
60 and under 70	15	290
Under 60	19	309
Not indicated	17	326

In 40 of the 51 industries for which the calculation (or a good estimate) can be made, inclusion of corporate data only would give more than a 90 percent coverage; in only 3 would less than a 70 percent coverage result.

If the Census, therefore, were to show its corporate data separately, grouping them according to the standard classification, a series of figures comparable with those published by the Bureau of Internal Revenue could be obtained; and such corporate figures, for the overwhelming majority of specific industries of this standard classification would undoubtedly represent more than 80 percent of manufacturing activity.[8]

However, there is no reason why the Census figures for *all* its establishments (incorporated and unincorporated combined) should not be shown by the standard classification grouping also. This should be done upon a basis of enterprise, as before outlined. While these figures would not be comparable with Internal Revenue figures as regards totals, they would, of course, be comparable in "industrial" coverage, and rates of change could be safely compared over short periods. Comparisons essayed for longer periods would depend, for their validity, upon the degree to which changes in the character of corporate and noncorporate activity resembled one another. But for this very reason, it is desirable to have the Census tabulate data for *all* enterprises according to the standard classification, as well as show separately the data for corporations included in the *Statistics of Income* groupings of this classification.

With respect to the Bureau of Labor Statistics, a far different situation prevails. The 20,000 establishments covered by the Bureau represent about 19,000 *firms*,[9] some of which are incorporated, some not. The Bureau does not know how many represent corporations; but this could readily enough be ascertained by inquiry on the reporting schedule. Lists could then be exchanged with the Census Bureau and

[8] At least, of the activity of establishments with a gross output of over $5,000 a year.
[9] Letter from Commissioner Lubin, dated May 15, 1934.

the Bureau of Internal Revenue, and the same enterprises be assigned to the same groupings of the standard classification by all three bureaus.

To achieve identity of coverage, however, it would be necessary for both the Census Bureau and the Bureau of Internal Revenue to designate, in their tabulations, the corporate enterprises included in the list of the Bureau of Labor Statistics. By showing separately the data for this list of enterprises, both complete comparability and identity of coverage could be obtained—so that the current monthly employment and payroll data of the Bureau of Labor Statistics could be directly compared with financial and output data for the same enterprises, collected annually and biennially by the other agencies. It would still be necessary, of course, for the Bureau of Labor Statistics to adjust its data to the biennial Census of Manufactures figures to correct any bias accumulated by its sample over a period.

VII

By way of summary it may be said that the objectives of a standard classification are as follows: (1) Uniformity of groupings in name; (2) identity of assignment of enterprises to groups; (3) segregation of corporate enterprise data from other data; (4) segregation, in the data of a larger list, of sets of data pertaining to the smaller lists (of another bureau or agency); and (5) separate showing of data for enterprises in which assignment to a specific industrial group is dubious.

To achieve this objective, the following measures would be necessary:

(1) Legal and administrative authorization for interchange of lists and data between different bureaus for statistical purposes; (2) experimental studies to determine: (a) percentages of output in one or another class of product, to underlie industrial assignment of enterprises on basis of "predominant activity," (b) volume of activity excluded from specific groupings because of miscellaneous character, (c) corporate activities as indices of all activities over short periods, and (d) importance of small enterprises, for inclusion or exclusion in data of the standard classification; (3) budgetary provision for both initial experimental work and current continuation.

RECENT PROGRESS IN STATISTICAL METHOD*

By Paul R. Rider, *Washington University*

In giving a review of recent progress in statistical method, it seems desirable to consider very recent progress only. *Social Science Abstracts,* during its brief period of publication, summarized the majority of papers appearing during the period 1928–1932. J. O. Irwin, in three excellent annual articles in the *Journal of the Royal Statistical Society,*[1] has outlined the advances in mathematical statistics during the years 1930, 1931, and 1932, respectively, with a certain amount of inevitable overlapping, and with some extension on the one hand into 1929 and on the other into 1933.[2] Surveys somewhat less complete have been given in *Econometrica* by Shewhart (145)[3] and Darmois (37). The former traces developments through 1932, the latter even includes some papers published as late as 1934. Mention should also be made at this point of an excellent exposition by Deming and Birge (44) of the modern theory of errors. The present paper will endeavor to pick up the threads of these other summaries and to give a brief digest of some of the important advances made by papers published in 1933 and the early part of 1934.

The task is not an easy one. The literature is very extensive, and to make selections from it is difficult. After selections have been made there is the problem of correctly interpreting material that is at times both abstract and abstruse, and presenting it in terms that involve a minimum amount of the technicality of the original memoirs. However, if some of the excellent work that is being done in the field of statistical theory today can be given a larger circle of acquaintance, or if some important pieces of research are brought to the attention of those who may find them useful, it will have been worth the effort, and the purpose of this paper will have been accomplished.

I. STATISTICAL INFERENCE. TESTING HYPOTHESES

Fundamental progress has been made on the question of statistical inference, particularly along the lines of testing hypotheses. Neyman

* Revision of a paper delivered at the Ninety-sixth Annual Meeting of the American Statistical Association, Chicago, Illinois, December 27, 1934.

[1] Vol. 94 (1931), pp. 568–578; vol. 95 (1932), pp. 498–530; vol. 97 (1934), pp. 114–154.

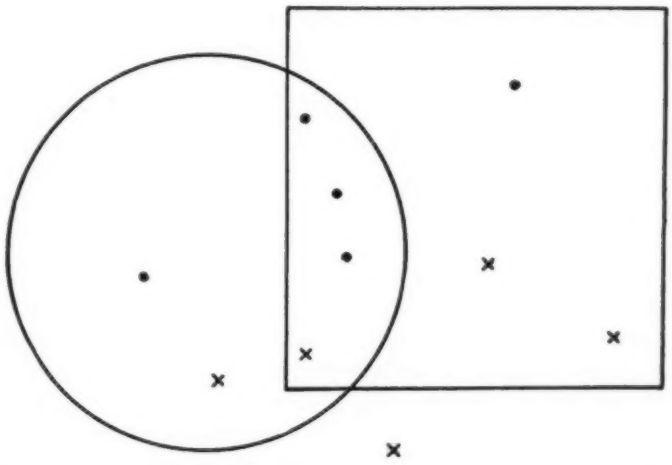
[2] The writer is especially indebted to Irwin's third review, upon which he has freely drawn in summarizing certain papers published in 1933.

[3] The numbers in parentheses refer to the numbers of the corresponding publications listed in the Bibliography at the end of this paper.

and Egon Pearson (111 and earlier papers referred to therein) have noted that in rejecting or accepting a hypothesis, two kinds of error are made:

1. The hypothesis is rejected when true.
2. It is accepted when false, that is, when some other hypothesis is true.

In determining how such errors may be controlled, these authors make use of the well-known fact that a sample of size n can be represented by a point in n-dimensional space. A test of a statistical hypothesis consists in a rule to reject the hypothesis when a certain character of the sample lies within specified limits, and to accept it or to remain in doubt in all other cases. In the sample space the critical limits for the character correspond to a *critical region,* and when the sample point falls within this region the hypothesis is rejected. To illustrate the method by which Neyman and Pearson attack this problem we shall, for simplicity, suppose that the space is of two dimensions, so that the points representing the samples lie in a plane. Let us consider the accompanying figure, which is similar to, but simpler than, the figure which they employ to explain their method. The



five dots represent the possible samples originating from the hypothesis H_0; the five crosses represent the possible samples originating from another hypothesis H_1, which is to be regarded as the only alternative hypothesis.

The probability of the first type of error can always be made as small as we please by a proper choice of critical regions. If in the case under consideration we wish to make the probability of rejecting

the hypothesis H_0 when it is true equal to 0.2 we could, for example, choose as our critical region that part of the plane outside of the circle. Since only one dot out of the five falls in this critical region we should in the long run reject H_0 when it is true one-fifth (0.2) of the time. The region outside of the square might also be chosen as a critical region so far as errors of the first type are concerned.

But for errors of the second type the situation is different. If the hypothesis H_1 is the true one and the region exterior to the circle is our critical region for rejection of H_0 we should err two-fifths of the time by accepting H_0 when a sample point falls within the circle (since there are two crosses out of five inside the circle). If the region exterior to the square is our critical region for rejection of H_0, we should be wrong three-fifths of the time by accepting H_0 when a sample point falls within the square. Of the two critical regions which err one-fifth of the time in rejecting H_0 when it is true, we should undoubtedly choose the region outside the circle since it makes the mistake of accepting H_0 when it is false less often than the region outside the square. Some critical regions are thus better than others.

This leads to the concept of "best critical region": of all possible regions for which the probability of rejecting H_0 when it is true has a constant value, we choose that region for which the probability of accepting H_0 when H_1 is true is a minimum; this is the *best critical region of H_0 with respect to H_1*.

In most cases the elementary probabilities corresponding to different hypotheses are continuous and differentiable functions, and we are concerned with integrating over a critical region rather than with counting the number of points in it. The problem can thus be reduced to a restricted minimum problem in the calculus of variations.

The solution is closely linked with the *criterion of likelihood,* which may be briefly explained as follows: The likelihood of a hypothesis is proportional to the probability that, if true, it will yield the observed sample.[4] For example the likelihood that the normal population

$$(2\pi\sigma^2)^{-\frac{1}{2}} e^{-(x-m)^2/2\sigma^2}$$

will yield the sample $(x_1, \ldots, x_n)$ is

$$\text{const.} \times (2\pi\sigma^2)^{-n/2} e^{-[(x_1-m)^2 + \cdots\cdots + (x_n-m)^2]/2\sigma^2}$$

The likelihood ratio of a hypothesis H_0 is

$$\lambda = \frac{\text{likelihood of } H_0}{\text{maximum likelihood}}$$

[4] See R. A. Fisher. On the mathematical foundations of theoretical statistics. *Philosophical Transactions of the Royal Society of London*, series A, vol. 222 (1922), pp. 309–368.

that is, the ratio of the likelihood of the hypothesis to be tested to the likelihood of that hypothesis of an admissible set (of which H_0 is a member) which affords the maximum probability for the observed sample. The criterion of likelihood consists in using for critical regions those bounded by the contours λ=constant.

In certain problems there is a common family of best critical regions for H_0 with respect to the entire class of admissible alternative hypotheses. In these problems the best critical regions are the same as the regions given by using the criterion of likelihood, although a general proof of this has not been obtained for the case in which H_0 is composite.[5]

In problems in which there is a different best critical region for H_0 with respect to each of the hypotheses constituting the admissible set of alternatives, the region resulting from an application of the principle of likelihood is the envelope of the best critical regions with regard to the individual hypotheses of the set.

Irwin (85) has pointed out that when the hypothesis concerns the value of a single parameter, the condition that there should be a best critical region reduces to the condition that the "statistic" used to estimate the parameter should be a *sufficient* statistic, that is, "no other statistic which can be calculated from the same sample provides any additional information as to the value of the parameter to be estimated".[6]

Neyman and Pearson illustrate their theory by a number of interesting examples. Some simple hypotheses tested are whether the mean of a normal population with given standard deviation has a specified value, whether the standard deviation of a normal population with given mean has a specified value, and whether a normal population has a specified mean and a specified standard deviation. Among composite hypotheses tested are whether the mean of a normal population has a specified value, the standard deviation being unspecified ("Student's" problem), and whether the standard deviation has a specified value, the mean being unspecified. Tests are given for the significance of the difference between two means, and the difference between two variances.

In this paper they did not give any detailed consideration to the question of *a priori* probability. More recently (112) they have discussed what statements of value to the statistician in reaching his final judgment can be made from an analysis of observed data, which

[5] If the parameters characterizing a hypothesis all have values which are specified *a priori* the hypothesis is said to be *simple*, otherwise it is *composite*.

[6] R. A. Fisher, *Mathematical foundations*, op. cit.

would not be modified by any change in the probabilities *a priori*.

Neyman and Pearson's work should prove especially valuable in sampling inspection in mass production.

Brandner (20) has applied their method to test whether two samples have been drawn from normal bivariate populations in which the coefficient of correlation has a common but unspecified value. He obtains a criterion which, if the two samples are of the same size, is related exactly, and for other cases closely, to Fisher's test of significance of the difference $z_1 - z_2$, in which $z = \frac{1}{2} \log [(1+r)/(1-r)]$.

Let us consider a critical region with a given probability of rejecting the hypothesis H_0 when true, and let H_i be an alternative simple hypothesis. The probability of rejecting H_0 when H_i is true has been termed by Neyman and Pearson the *power* of the critical region with respect to the hypothesis H_i. If for a second critical region this probability is greater, the test based on this region is said to be more powerful than the test based on the first region. Clearly, a test T which is more powerful with regard to one alternative H_i than a test T_1 may be less powerful with regard to some other alternative H_j. It may happen, however, that for any alternative H_i whatever belonging to a given class, the test T is more powerful than T_1 with regard to H_i. In such a case T is said to be *uniformly more powerful* than T_1 with regard to the class of alternatives.

Fisher (59) has shown that those tests of significance and only those which are based upon sufficient statistics can be of the kind termed uniformly most powerful with regard to a class of alternative hypotheses. He has further shown that when a sufficient statistic exists the likelihood function involves only that statistic and the parameter to be estimated, and has obtained a general form for the sampling distribution of sufficient statistics.

The essential feature of sufficient statistical estimates is that they convey the entire information, contained in the sample of observations, concerning the values of the parameters of which they are estimates. When no sufficient statistic exists the precision of estimation may be enchanced by the use of ancillary statistics. Fisher has defined and illustrated a class of cases in which the totality of the ancillary information supplied by the observations may be utilized. The process gives a very simple derivation of sampling distributions in which there is no loss of information even for small samples.

Egon Pearson and Wilks (118) have taken k samples of a correlated pair of variables x and y and have considered the problem of testing

whether these samples can be differentiated owing to significant differences in the mean values of x and y or in the variation and covariation (of the residuals) within the samples. They have derived criteria for testing the following three hypotheses concerning the populations from which the samples were drawn:

H: That the populations are identical.

H_1: That the populations have the same set of standard deviations and correlations but have means with any differing values whatever. (The technique of analysis of variance appears to be unsuited to deal with this hypothesis when there are more than two samples.)

H_2: That the populations have the same set of standard deviations and correlations when it is assumed that $\bar{x}_t = \bar{x}$, $\bar{y}_t = \bar{y}$ $(t = 1, 2, \ldots, k)$.

These are generalizations to two variables of the three hypotheses considered previously by Neyman and Pearson [7] for k samples of a single variable, or they may be regarded as special cases of a more general problem considered by Wilks.[8]

The authors have given certain practical illustrations of the theory. For example, certain tests of manufactured goods are destructive and it is desirable to replace them by correlated measures which are non-destructive. In dealing with metal products a measure of hardness, based on a non-destructive test, is sometimes used as an index of tensile strength. However, if tensile strength is to be predicted from hardness by the correlation method, it is essential for the relationship between these two qualities to remain stable; it should not change from plant to plant or from month to month. The criteria developed by Pearson and Wilks enable us to test this stability. Another application which they make is an examination of inter-racial uniformity in the relationship between length and breadth of skull.

Thompson (156) has devised a method of judging between two rival treatments of a class of individuals upon the basis of the probability of occurrence of a given critical event following such treatment.

A lively argument has been taking place between Jeffreys and Fisher concerning certain phases of statistical inference. This arose out of a paper by the former entitled "An alternative to the rejection of observations".[9] No attempt will be made here to go into the

[7] *Bulletin de l'Académie Polonaise des Sciences et des Lettres*, serie A (1931), pp. 460–481.

[8] *Biometrika*, vol. 24 (1932), pp. 471–494.

[9] *Proceedings of the Royal Society of London*, series A, vol. 137 (1932), pp. 78–87.

subtleties of the discussion or the logical implications involved, but those interested are referred to (89, 91, 92, 57, 58, 13) and other papers mentioned in these references.

II. SAMPLING DISTRIBUTIONS OF STATISTICAL FUNCTIONS MOMENTS AND SEMI-INVARIANTS

Wilks has done some extremely important work in finding the distributions of the generalizations of certain statistical functions, such as variance, correlation ratio, Student's ratio, and the Neyman-Pearson λ criteria, in samples from a normal multivariate population. His latest contribution (162) consists in developing operational methods for finding the moments of a more general class of statistical functions directly from the probability law of the sample. The generality consists in the fact that some of the variates are treated as independent or fixed, that is, not subject to sampling variations. This permits the results to be applied to least squares regression problems in which the values of the independent variates are known without error. The results are also applicable, as for instance in the case of the multiple correlation coefficient, to problems in which an arbitrary number of the independent variates are subject to sampling error.

Wishart and Bartlett have used the theory of the moment generating function to deduce the known random sampling distributions of the estimated variance and covariance in a system of variables following the normal law of frequency. Recently (167), by means of the same general method they have obtained the simultaneous distribution of the $\frac{1}{2} p (p + 1)$ second order moment statistics in a normal system of p mutually correlated variables, and have shown that it is independent of that of the p sample means.

The product moment distribution of p normal variates has been used in the particular case $p = 2$ to deduce the distributions of the correlation coefficient, the covariance, and the regression coefficient, and in the general case to furnish a proof of Fisher's distribution of the multiple correlation coefficient and in connection with the idea of generalized variance. Bartlett (12) has shown that this product moment distribution can be split up into a chain of independent factors, and that most of the known distributions related to regression or to partial correlation can be simply obtained in a manner which clearly indicates the relations they bear to one another; the distribution of a partial regression coefficient of any order may also readily

be derived. He has further shown that the assumption of a normal system is not altogether necessary for some of the distributions to hold. In order to exhibit the minimum assumptions about normality that are necessary for the various distributions obtained, he has deduced *ab initio* a distribution which may be regarded as a further generalization of the product moment distribution, namely, the generalized partial product moment distribution.

Other new distributions that have been worked out are those of Student's ratio for samples of three from a rectangular population (127), $\sqrt{\beta_1}$ (101) and β_2 (102, 123) for samples of four from a normal population, the range in samples of three from normal (104).

Brown (23) has taken up the well-known problem of sampling from compound populations. From a consideration of the problem of dissecting a frequency distribution into its components he is led to a division of his investigation into two main parts. In the first part is taken up the case of sampling from a population made up of two components with no knowledge of the proportion contributed to the total frequency of the sample by each of the two components. Previously obtained results for sampling from a single parent population can be used if we have expressions for the parameters of the compound parent in terms of the parameters of its components. These expressions are derived in Part 1. In Part 2 a method is developed for dealing with samples of N $(=r+s)$ obtained by combining samples of r and s respectively from two distinct parent populations, this being essentially the situation which confronts us if we know the proportional contribution to the total frequency of a sample by each of the two components of a composite distribution.

Baten (14, 15) has also dealt with the question of combining samples from two or more populations and has presented some peculiar probability functions which arise when special laws for the individual variables are considered. He has also found (16) the distribution of totals from a parent population of the type $y = (1/2h)$ sech $(\pi x/2h)$.

The linear distribution is fundamental to a large class of problems. "For example," to quote from Lawther (95), "in many manufacturing operations it is economical to turn out items (such as bearing balls, paper condensers, or spacing washers) in large quantities with rather coarse precision. By means of gauges set to limits narrow as compared with the total spread, the product is then selected into bins, and in the operation of assembly a completed article utilizes the material from a single bin. The contents of any bin clearly may be

expected to follow a linear distribution very closely, and if the relative proportions of the product finding their ways into this bin and its immediate neighbors can be learned, the distribution may be specified with practical accuracy." Lawther has developed a new angle of approach to the analysis of the distribution of totals of samples of n from a linear (including rectangular and right triangular) distribution.

In an earlier paper Hojo [10] has compared the standard error of the mean with that of the median, and the standard error of an estimate of the population standard deviation obtained from the sample standard deviation with that of another estimate obtained from the interquartile distance. More recently (81) he has given the standard error of the mid-point between quartiles, and the standard error of an estimate of the population standard deviation obtained from the distance between a quartile and the median.

Romanovsky (135) has discovered an interesting property of the mean ranges in samples from a normal population. McKay and Egon Pearson (104) have obtained new results regarding the form of the range curve at its terminals.

Davies and Egon Pearson (40) have compared various methods of estimating from samples the population standard deviation. Space hardly permits stating their conclusions here, but the practicing statistician will find these conclusions very helpful.

An infinite population of one or more variables having finite moments may be regarded as completely specified by a knowledge of all its characteristic parameters, which may be moments or semi-invariants, or expressible in terms of these. For a random sample of size n taken from this population we may calculate certain functions which are to be regarded as estimates of the population moments or semi-invariants. Fisher has shown that if we take as estimates of the population semi-invariants κ_r certain functions k_r (called *k-statistics* by Fisher) of the sample observations characterized by the property that the mean value of k_r for an infinite number of samples is κ_r, then the semi-invariants of the k's are much simpler in form than analogous expressions derived in other ways. However, it is desirable in some work to have the moments of the distribution of sample moments expressed in terms of the moments of the parent population, and Wishart (166) has shown how to obtain these from the semi-invariants of Fisher's k-statistics by making use of results developed by C. C.

[10] *Biometrika*, vol. 23 (1931), pp. 315–360.

Craig [11] and St. Georgescu.[12]

Geary (68) has developed a general expression for the moments of the function $m_p/m_2^{p/2}$, in which m_p is the moment of order p in a sample of n from a normal population.

Allen T. Craig (35) and Ayyangar (9) have given new methods for obtaining recurrence formulas for the moments of the point binomial distribution, and the latter (10) has also given a simple method of deriving the recurrence formula for the moments of the hypergeometric series.

Castelnuovo (32) has made important contributions to the solution of the problem of moments, that of finding a frequency function possessing given moments.

III. FREQUENCY CURVES AND SURFACES. CORRELATION AND REGRESSION

It will be remembered that Pearson's frequency curves are obtained by integrating the differential equation

$$\frac{1}{y}\frac{dy}{dx} = \frac{-(x+a)}{c_0 + c_1x + c_2x^2 + \ldots\ldots + c_nx^n}$$

in which only the first three terms of the denominator on the right are retained. But in certain cases a Pearson curve may not give an adequate fit to a distribution, and it is quite natural to inquire to what extent matters will be bettered by the use of more c's in the foregoing equation, that is, by the use of higher moments. Heron investigated the third order Pearson curves corresponding to the case in which the polynomial denominator is taken to be $c_0 + c_1x + c_2x^2 + c_3x^3$, but his work was not published, because the addition of the c_3-term did not as a rule materially improve the goodness of fit to actual distributions. Hansmann (78), however, has included the c_4-term, but has limited himself to the symmetric case $c_1 = c_3 = 0$. He has shown that these fourth order symmetric Pearson curves give a better graduation than the second order curves, and that the improvement in fit, as judged by the χ^2 test, justifies the extra labor involved.

Fisher [13] has shown that the system of curves for which the method of moments is the best method of fitting is an exponential function with a fourth degree argument. O'Toole (113, 114) has given an extended discussion of this system of curves.

[11] An application of Thiele's semi-invariants to the sampling problem. *Metron*, vol. 7, no. 4 (31 Dec. 1928), pp. 3–74.

[12] Further contributions to the sampling problem. *Biometrika*, vol. 24 (1932), pp. 65–107.

[13] *Mathematical foundations.*

Baker (11) has studied the transformation of non-normal into normal frequency distributions. Such transformation he effects by using Maclaurin expansions and equating coefficients. Since a non-normal distribution and the transformation necessary to carry it into a normal distribution serve to specify the distributions in random samples of estimates of the parameters of the original distribution in terms of the distributions of estimates of the parameters of a normal distribution, Baker's work seems to afford a method of obtaining approximations to the distributions of estimates of parameters from a non-normal population.

After a frequency function has been fitted to a set of data, it may be desirable to change the origin, the scale, or the total frequency. Zoch (171) has discussed certain invariants and covariants of such transformations applied to Pearson curves.

Wicksell (160) has studied, by means of characteristic functions, the correlation surface of the second order moments in random samples of x and y drawn from a normal bivariate population. He finds that the joint distribution of $z_1 = \Sigma x^2/n$ and $z_2 = \Sigma y^2/n$, in which x and y are deviations from the population mean, is of Type III in both of its marginal distributions and consequently may be regarded as a Type III frequency surface. He also finds the distribution of $z_1 = \Sigma x^2/(n + n_1)$ and $z_2 = \Sigma y^2/(n + n_2)$. The n first sample values are taken from individuals for which both x and y are given, that is, n pairs of x and y are first taken. The remaining n_1 x's are taken from individuals for which y is not observed and the remaining n_2 y's from individuals for which x is not observed. The correlation surface of $z_1 = \Sigma x^2/n$, $z_2 = \Sigma y/n$ turns out to be Type III in one margin and normal in the other.

Wicksell finds a generalized form of Type III as the distribution function of the second order moment (for one variate) taken about a fixed point at a given distance from the population mean. This function is a special case of the development of a generalized Type III distribution given by Romanovsky [14] but is not open to the objections advanced by Karl Pearson against Romanovsky's generalization. As pointed out by Egon Pearson, it is identical with a function studied by Fisher in connection with his investigations of the "General sampling distribution of the multiple correlation coefficient." [15]

Yuan (170) has studied the logarithmic frequency distribution and

[14] *Biometrika*, vol. 16 (1924), pp. 114–116.

[15] *Philosophical Transactions of the Royal Society of London*, series A, vol. 121 (1928), pp. 654–673.

the semi-logarithmic correlation surface and has opened up a new way for determining exponential and logarithmic regression curves.

The importance of the theory of frequency functions of two or more discrete variables can hardly be denied, yet this topic has been somewhat neglected. It is therefore gratifying to see it taken up by Guldberg (74), who has used difference equations for deriving recurrence formulas for the moments of a given frequency function. The bivariate functions considered are the Bernoulli, the Poisson, the Pascal, and the hypergeometric. Guldberg has also established criteria for indicating whether a statistical series of double entry may be approximately represented by a certain type of frequency function of two variables. Wicksell (161) has treated the case of discrete variates in his study of regression theory.

Mention should also be made of a very instructive paper by Guldberg (72) on frequency functions of a single discrete variate. The author uses the difference equation satisfied by a frequency function to obtain expressions for the complete and incomplete moments of the function.

Pollaczek-Geiringer (130) has proposed the problem of constructing a "model" of a bivariate distribution for which one can compute explicitly a desired measure of correlation, such as the coefficient of correlation r or a measure of contingency f^2, and so that one can then obtain a more concrete representation of the dependence relation existing in a given distribution, either empirical or theoretical, by comparison with the corresponding model. The object is to give a set of distributions (containing only two parameters if possible) so that every given pair of values (r, f^2) is realized by a model in the set. Her solution of this problem is extremely enlightening from the viewpoint of correlation theory.

Fréchet (60)[16] has shown how the ordinary coefficient of correlation between x and y can be separated into the product of two factors: 1. The coefficient of correlation obtained by associating with each value of x the mean of the corresponding values of y weighted with the number of such y's. 2. The correlation ratio formed by the standard deviation of the means of the various columns (weighted by the number of items in the respective columns) about the general mean of the y's, divided by the standard deviation of the y's. The first factor depends only on the curve of the means and not on the dispersion, the second, on the contrary, is not affected when the partial distributions of the columns are displaced by deforming the

[16] See also the summary of Fréchet's paper in (37), free use of which has been made here.

curve of the means. Thus the first factor does not depend on the closeness of the relation. On the other hand, the value of the correlation ratio may be near unity for two reasons, either because the points y corresponding to a given x are near the curve of the means, or because there is a small number of y's for each value of x. In the latter case it is not legitimate to deduce from any sort of an index of correlation a conclusion regarding the precision of the relation which determines y from a given value of x.

Fréchet advocates the use of the correlation ratio instead of the correlation coefficient, but thinks that better than the former would be a correlation index satisfying the following conditions: 1. between 0 and 1 in value; 2. equal to unity when and only when the dispersion of Y for $X = x$ is zero for any x; 3. equal to zero when and only when the mean and the dispersion of Y for $X = x$ are independent of x. He has devised an index possessing these properties (62).

Correlation due to a common factor has been a somewhat familiar subject of study. The latest development along this line is contained in a paper by Carl Fischer (54), which is concerned with the correlation among sums having common elements. Fischer assumes drawings made from a continuous population, defines n sums, each of an arbitrary number of elements, formed in such a way that any two consecutive sums have elements in common, and inquires into the correlation between any two of these sums. More recently (55) he has extended results to include the multiple and partial correlation coefficients involved. A. T. Craig (34) has investigated the case of a set of variables, $x_1, x_2, \ldots, x_n$, in which x_1 is correlated with x_2, x_2 with x_3, and so on.

The last named writer (33) has established theorems, applying to any type of universe, which make possible the determination of the type of regression of the median on the arithmetic mean, of the range on the median, and of the range on the arithmetic mean. In case the regression is linear, the coefficient of correlation may be computed.

Merzrath (109) has studied the question of correlation and regression from the standpoint of surfaces fitted to data. The surfaces considered are of the types

$$z = P(x,y)e^{-\frac{1}{2}(x^2/\sigma_x^2+y^2/\sigma_y^2)}, \quad z = P(x,y)e^{-(x^2+y^2)/(\sigma_x^2+\sigma_y^2)}$$

in which P is a polynomial.

Andersson [17] has worked out a simple and widely applicable numerical method of computing curved regressions based on a general principle due to Wicksell. This principle may be stated as follows: After fitting a suitable univariate frequency function with a limited number of parameters to the marginal distribution of the independent variate, the moments of this function, which are all expressible in terms of the parameters, should be used, instead of the moments of the observations, in computing the regression coefficients. When this this device was applied to the ordinary least squares expression for the regular coefficients it was clear that a departure from the least squares condition took place, although this seemingly did not harm the result and the computations were much simplified. Andersson (6) has recently adjusted his method so that it is turned into a strict least squares solution, but states that the original (unadjusted) method is numerically simpler in application and gives regression curves that are practically as good as—sometimes even better than—those afforded by the adjusted method.

Quite recently Wicksell (161) has made a study of regression from a different standpoint, namely that of characteristic functions, which have proved so useful in the expansion of distribution functions in series and in describing observed distributions. He has shown how characteristic functions may be used in finding series expansions of complicated regressions. It turns out that the convergence of such expansions, and hence the choice among different modes of expansion, depend fundamentally on the nature of the marginal distribution of the independent variate. Since the theory of univariate frequency functions is much further developed than the theory of bivariate or correlation functions, the power gained by Wicksell and his pupil Andersson in taking advantage of the former theory in studying regression may readily be realized.

IV. MISCELLANEOUS

Poisson's exponential formula for the frequency of occurrence of rare events holds under the following assumptions:

1. The probability for the occurrence of the event is independent of the time,
2. The probability for the occurrence of the event is very small,
3. The individual occurrences are independent of each other.

If we do away with the third assumption we obtain the Eggen-

[17] Researches into the theory of regression. *Meddelande från Lunds Astronomiska Observatorium*, series 2, no. 64 (1932), 115 pp.

berger-Pólya formula for the probability of exactly r occurrences of the event, viz.:

$$P_r = (1/r!)h(h+d)\ (h+2d)\cdot\cdots\cdot(h+\{r-1\}d)\ (1+d)^{-h/d-r}$$

$$h=\text{mean},\ h(1+d)=\mu_2 \quad \text{or} \quad d=\frac{\mu_2}{h}-1=\frac{\mu_2-\text{mean}}{\text{mean}}.$$

The Eggenberger-Pólya formula finds application in the statistics of contagious diseases. H. Pollaczek-Geiringer's [18] derivation of it from an urn schema seems very artificial. She however gives a formula which serves as a broad generalized statement for the theory of rare contagious events. In a paper by Lüders (99) this formula is derived from a special standpoint. Certain special cases are discussed, and the connection with the Eggenberger-Pólya formula is explained. Further, the question of mean value is investigated. The results of the theory are illustrated by examples.

The hypergeometric series $F(\alpha, \beta, \gamma, 1)$ is intimately connected with probability problems. For example, in drawing a sample of n from a finite population, the probability of obtaining exactly r individuals possessing a certain character can be represented by the $(r+1)$th term of such a series provided proper values are assigned to the elements α, β, γ. The probability integral of the series, that is, the sum of the first $r+1$ terms, representing the probability of obtaining at least r individuals possessing the character, is of considerable importance. Davies (39) has given an approximate method of evaluating this integral by fitting to it a Pearson curve.

It is well known that the Pearson curves can be obtained from the differential equation [19]

$$\frac{1}{y}\frac{dy}{dz}=\frac{y_{r+1}-y_r}{\frac{1}{2}c(y_{r+1}+y_r)}$$

in which y_r is the r th term of the series $F(\alpha, \beta, \gamma, 1)$. Let the Pearson curves be represented by $y=P(z)$. When the last element of F is not unity, the resulting system of frequency curves is of the form $y=e^{-\rho^r}P(z)$. Davies has extended his study to this more general system.

Schmidt (141) has made a study of frequency distributions from a somewhat novel standpoint by dealing with the inverse of the integral of a frequency function.[20] He uses the "best" values of a

[18] Über die Poissonsche Verteilung und die Entwicklung willkürlicher Verteilungen. *Zeitschrift für angewandte Mathematik und Mechanik*, vol. 8 (1928), pp. 292–309.

[19] See H. L. Reitz, *Mathematical Statistics*, Chicago, Open Court (1927), pp. 52–53.

[20] Cf. the Kelley-Wood Table of the Normal Probability Integral in Truman L. Kelley, *Statistical Method*, New York, Macmillan (1923).

frequency function in the sense defined by A. Ekke in his Kiel dissertation (to appear) as follows: For a given number n divide the area under a frequency curve $y = \phi(x)$ into n equal parts by $n-1$ abscissas. (If n = 10, for example, these abscissas will be the deciles.) Bisect each of these subareas by means of n abscissas $\xi_1, \ldots\ldots, \xi_n$ (which we assume arranged in ascending order) so that the area between any two consecutive ξ's is $1/n$ of the total area under the curve. (The area between $-\infty$ and ξ_1 is $1/2n$ of the total area, as is the area between ξ_n and ∞.) These ξ's are the *best* values, and have certain interesting properties proved by Ekke. For example, if

$$S(x; x_1,\ldots.x_n) = \begin{cases} 0 \text{ in } -\infty < x < x_1 \\ \nu/_n \text{ in } x_2 \leqq x < x_{\nu+1} \\ 1 \text{ in } x_n \leqq x < \infty \end{cases} \quad (\nu = 1,\ldots, n-1)$$

then there is one and only one set $x_1, \ldots\ldots, x_n$ for which

$$\int_{-\infty}^{\infty} [\phi(x) - S(x; x_1,\ldots\ldots,x_n)]^k dx$$

is a minimum and this set is $\xi_1, \ldots\ldots, \xi_n$.

After determining the "best" values $\xi_1, \ldots\ldots, \xi_n$ corresponding to a given frequency function, Schmidt forms the set of vectors

$$E_k = (\xi_1^k,\ldots\ldots, \xi_n^k), \ (k = 0, 1,\ldots., n-1)$$

which he normalizes and orthogonalizes into the set z_k. If $x_1, \ldots., x_n$ are a set of observations then E is the vector $(x_1, \ldots., x_n)$. The *Tchebychef coefficients* are defined as the products $z_k E$. (It should be noted that Schmidt defines the product UV of two vectors $U = (u_1, \ldots., u_n)$ and $V = (v_1, \ldots., v_n)$ as the number $(1/n)$ $(u_1v_1 + \ldots\ldots + u_nv_n)$, that is, $1/n$ of the ordinary dot product. The first three, called dispersion, skewness, and kurtosis respectively, correspond to the functions ordinarily designated by these terms. The definitions are readily extended to grouped observations. These Tchebychef coefficients are fundamental in Schmidt's theory. He utilizes them in fitting curves, and by means of them gives some rather illuminating concepts of skewness and kurtosis. A condensed version of Schmidt's developments is to be found in *Econometrica* (63).

We have Sheppard's well-known corrections for grouping in the case of moments of frequency curves having high contact at both ends, and also corrections for abruptness.[21] Now adjustments for the

[21] Gertrude E. Pearse, On corrections for the moment coefficients of frequency distributions

various moments of *J*-shaped curves are being suggested (51, 122).

Carver (27), in an interesting note on the modification of moments, has discussed a formula, corresponding to Sheppard's correction, for the case in which discrete variates are grouped into classes. More recently Abernethy (1) has shown that Sheppard's and Carver's corrections give the most probable value of the true moments of a distribution about an arbitrary origin in the sense that they give an approximate value for a given moment which is correct on the average. That is, these formulas eliminate the systematic errors due to grouping, whatever the distribution function, so long as the moments under consideration exist.

In certain statistical data, such as cases of disease incidence in infancy, incomes, property-valuations, and divorces, the exact point at which the frequency begins, is not evident. For example, the number of cases of whooping cough for children under one year of age may be recorded, but it is very unlikely that any of these were under three months; the number of divorces occurring during the first year of marriage may be given, but there is a certain minimum time which the legal formalities require. Methods hitherto used for fitting curves to such distributions have assumed the frequency to commence at zero, "but this assumption may not only give poor results for the moments, but, in the case when the first frequency is less than the second, may make the distribution appear non-asymptotic when it is really asymptotic." Martin (106) has investigated the possibility of determining the start of the frequency by means of an auxiliary curve and has examined the improvements thereby obtained in the evaluated moments of the distribution.

On account of mathematical difficulties it is not always possible to obtain an algebraic solution of maximum likelihood equations. It has been shown by Fisher [22] that under such circumstances it is possible to start from an inefficient statistic, and to obtain, by a single process of approximation, an efficient statistic. Koshal (94) has applied the method to improve certain statistics obtained by the method of moments. The chief interest of his paper lies in the treatment of the two practical difficulties caused by grouped data and by the use of a type of curve in which the equations of maximum likelihood involve integrals of a troublesome form. Elderton and Hansmann (52) have later pointed out that the fit of curves obtained by the

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when there are infinite ordinates at one or both of the terminals of the range. *Biometrika*, vol. 20A (1928), pp. 314–355.

[22] R. A. Fisher, Theory of statistical estimation. *Proceedings of the Cambridge Philosophical Society*, vol. 22 (1925), pp. 700–725.

method of moments can be improved by ways which are much simpler from the standpoint of arithmetical calculation than the method illustrated by Koshal.

In discussing the distribution surface of the difference between two variables each of which follows a Type III curve, Karl Pearson (121) is led to a study of the function

$$K_{\tau_1,\,\tau_2}(x)=\frac{\pi^{\frac{1}{2}}}{2^{\nu}\,\Gamma\,(\nu+\frac{1}{2})}x^{\nu}\int_1^{\infty} e^{-xt}(t-1)^{\tau_1}(t+1)^{\tau_2}\,dt,\ \nu=\tfrac{1}{2}(\tau_1+\tau_2+1)$$

which he calls a *double Bessel function.* The functional symbol which he uses is somewhat like his monogram, with the P reversed, but as notations involving special characters seem undesirable, especially when unnecessary, we have used an ordinary K. If $\tau_1=\tau_2$, $K_{\tau_1,\,\tau_2}(x)$ becomes the Bessel function $K_\nu(x)$, $\nu=\tau_1+\frac{1}{2}$. Pearson finds it convenient to use the function

$$T_{\tau_1,\,\tau_2}(x)=x^{\nu}\,K_{\tau_1,\,\tau_2}(x)\ /\ \pi^{\frac{1}{2}}\,2^{\nu}\Gamma\,(\nu+\tfrac{1}{2}).$$

He states that this function arises naturally in the consideration of some important statistical problems, and, after developing certain of its properties, promises to provide tables and to illustrate the type of problems which they are designed to solve.

Constance Rigby (133) has developed a recurrence relation connected with the above K and T functions.

Certain extensions have been made in that useful method, the analysis of variance. Brandt (21) has considered the case of a 2 x s table with disproportionate frequencies, and Yates (169) has discussed the still more general case of a p x q table. T. W. Schultz and Snedecor (143) have applied the method in handling the time element in economic statistics. Kemp (93) has given new ways of developing or using relationships already known. It seems appropriate at this point to mention the excellent little book of Snedecor (150) which makes clear, by means of well worked out examples, various phases of the method.

Wishart (165) has reviewed recent progress in the theory of orthogonal polynomial fitting, and this topic will not be included in the present review. A number of papers on orthogonal polynomials and orthogonal functions will, however, be found listed in the Bibliography.

In the Charlier Type-B expansion arise certain polynomials which may be called Charlier polynomials. Doetsch (47) has studied

these polynomials from the standpoint of the differential-difference equation which they satisfy.

Let us consider n variables $x_1, x_2, \ldots, x_n$, ordinarily correlated, attaching to each individual of a population. These variables might for example be scores made by students in certain tests. It is natural to inquire whether there exists some more fundamental set of independent variables, perhaps fewer in number than the x's, which determine the values the x's will take. One of the latest writers to consider this problem is Hotelling (82), who has given an orderly procedure for selecting these new variables, which may be termed *components* of the x's, in the order of definiteness of their existence or of their importance for the purpose at hand, and of rejecting any which prove to be of little importance, or which are not clearly defined by the data. Since the components mentioned above are the so-called *factors* of Spearman's theory, psychologists interested in this theory are referred to Hotelling's paper and also to papers by Irwin (84), Piaggio (128), Spearman (151), and Camp (26).

Doob (48, 175) has apparently given a rigorous proof of the validity of R. A. Fisher's method of maximum likelihood.

By imposing an additional condition, S. Bernstein [23] was able to obtain a better limit for Tchebychef's inequality. His work, being in Russian, seems to have escaped notice in the English-speaking world. C. C. Craig (36), in calling attention to it, has shown how Bernstein's result can be obtained under less severe conditions than those imposed by Bernstein himself.

The moments for samples of a given size from a finite population depend upon the size of the sample. O'Toole (116) has given an answer to the question: What is the best size of sample to use?

Gruzewska (71) has obtained an expression for the probable precision of a weighted average, extending a problem of Bowley to the case in which the variates and their weights are correlated.

Margaret Merrell (108) has given some interesting relations between β_1 and β_2 for the point binomial distribution.

Alter (5) has presented a new form of periodogram as powerful as the correlation form and so simple that it requires little more than one-third as long to compute.

Regan (131) has extended the concept of admissible numbers in probability, developed by Copeland, to time series.

Steffensen (153, 154) has suggested a modification of Karl Pearson's mean square contingency, the object of modification being to make the measure remain applicable when the number of distinct

[23] *Theory of Probability.* Moscow (1927).

values which the statistical variables can assume becomes infinite. Pearson (126), however, maintains, and adduces some good examples to strengthen his point, that his coefficient of mean square contingency has certain advantages over the proposed modified form.

Letting $y_n(r)$ be the ordinate [24] of the distribution curve of the correlation coefficient in samples of n from a normal bivariate population, Garwood (67) has obtained the integral $\int_{-1}^{r} y_n(r)dr$, which is the probability of drawing a sample with a correlation coefficient less than r. He states that his formulas become, for larger samples, too complicated for practical use, and that Miss F. N. David, who is computing the probability integral table for r in small samples, uses them for the smallest samples only, proceeding in a different manner for the larger sample sizes.

Among writers who have considered the question of the center of population are Linders (97), Griffin (70), Galvani (66), Scates (139), and Gini, Boldrini, Galvani, and Venere (69).

If $y = f(x)$ is the equation of a frequency curve defined between the limits a and b, then the corresponding *concentration curve* is the curve whose abscissa and ordinate are respectively,

$$p = \int_a^x f(x)\,dx \Big/ \int_a^b f(x)\,dx, \quad q = \int_a^x xf(x)\,dx \Big/ \int_a^b xf(x)\,dx$$

Castellano (30) has discussed the relations between frequency curves and their concentration curves.

Two sets of quantities being given, the *probability of transvariation* may be defined as twice the probability that if a quantity is selected at random from each set, their difference will have the opposite sign to that of the difference between the medians of their respective sets. Castellano (31) has given formulas for calculating the standard deviation of this measure.

Deming (43), following up a previous paper, has presented further illustrations of the adjustment of observations and determination of parameters, together with suggestions for systematic procedure in computation. He has treated the logarithmic decrement of a balance, the exponential law, and the laws represented by the equations $ya^x = b$, $yz^x = b$, $yz^x = w$.

The mean of a set of numbers $x_1, x_2, \ldots$ may be defined as any function $m = f(x_1, x_2, \ldots)$ such that $f(x, x, \ldots) = x$. Such a mean may be infinitely-many valued, it may be external to all given

[24] For the expression for $y_n(r)$ see Garwood's paper, or R. A. Fisher, *Biometrika*, vol. 10 (1914–15), p. 507.

values $x_1, x_2, \ldots, x_n$, it may be discontinuous. Among the properties designated by internal, unique, homogeneous, translative, symmetric, increasing, monotone (increasing), associative, and continuous, some dependence has already been discovered. Very recently Dodd (46) has shown that the first five of the foregoing properties are completely independent, also the set from the second to the sixth, inclusive, and some other sets.

Carver (29) has called attention to some of the possibilities of punched card systems in the analysis of data. He states that "the recent development of the Automatic Multiplying Punch is unquestionably the most important contribution to the mechanics of mathematical statistics since the invention of adding and multiplying machines." By computing moments and product-moments exactly, without the grouping of variates, it dispenses with Sheppard's and similar corrections. It is even possible to evaluate linear functions of one or more variables with this machine and subsequently to print the graduated values. Undoubtedly we are due to see in the near future remarkable progress in the uses to which punching, sorting, and listing machines can be put.

McKay (103) has described a simple and inexpensive sorting system which depends on the principle of punching cards, but, unlike other systems, employs only the peripheries of the cards and not their interiors. He has shown some of the possibilities of this system in handling statistical data.

Mallock (105) has described an electrical machine for solving sets of linear algebraic simultaneous equations involving a large number of unknowns, and thus useful in the method of least squares. This machine consists of a set of alternating current transformers each with a number of windings, the unknowns being proportional to the fluxes in the transformers and the coefficients to the number of turns in the windings.

Important tables which have appeared are the long-heralded *Tables of the Incomplete B-Function* (119) and an excellent set of *Tables of the Higher Mathematical Functions* prepared under the direction of Davis (41.) The latter book includes articles on the classification and history of tables, modern mathematical methods of calculation, and interpolation, and provides tables of interpolation coefficients and tables of the Gamma and Psi functions.

ADDENDUM. Allen T. Craig has called attention to an important paper by Cochran (176) which had been inadvertently overlooked by the writer. Among the theorems proved is the following, which has valuable application in the analysis of variance: If $x_1^2 + \ldots +$

$x^2_n = q_1 + \ldots + q_k$ where the q's are each distributed as χ^2 with degrees of freedom $n_1, \ldots, n_k$ respectively and $n = n_1 + \ldots + n_k$, then the q's are independent. See (86). Unfortunately it is not possible to go more fully into Cochran's paper.

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NOTES

THE MECHANICS OF THE TABULATION OF THE POPULATION CENSUS

By Leon E. Truesdell, *Bureau of the Census*

The initial tabulation of the population census is a simple count of the names returned, known in the Census Bureau as the "hand count," to distinguish it from the more complicated machine counts which furnish most of the figures contained in the census reports.

The first count of the 1930 schedules was made by the field supervisors, before the schedules were sent to Washington. On the basis of this preliminary count, preliminary announcements of population were made by these supervisors, which announcements, in the great majority of cases, differed but little from the final figures. Upon receipt of the schedules in Washington, the final and official count was made, as expeditiously as possible. Upon this count was based the statement of the population by states, for apportionment purposes, which forms the constitutional justification for the entire census; the first series of state bulletins on population; and the first volume of the final reports, which gives the population of the United States, states, counties, cities, townships, etc. All of the remaining tabulations, which are devoted to classifications of the population according to various characteristics, such as color, sex, age, and occupation, were made by machinery.

The punch card.—The first step in the detailed tabulation of the population data is to punch a card for each person enumerated. The population card is 6 5/8 by 3 1/4 inches, the same width as the standard 45-column card used in commercial tabulation but 3/4 of an inch shorter. The card contains 24 columns, the columns being farther apart and the punched holes considerably larger than in the case of the 45-column commercial card. Prior to 1930, the population card was laid out in more or less irregular fields rather than in columns, and was punched on the Pantograph punch, which permitted punching two or more holes in one column without extra work or any special arrangement. Since the Pantograph punch was slow in operation and none too accurate, the 1930 card was rearranged and adapted for use on the commercial punch. It is therefore set up in regular columns and calls for only one hole to be punched in any column. (See cut, p. 90.)

POPULATION CARD—1930 CENSUS

15-165
CENSUS BUREAU — POPULATION, 1930

Area 1	Area 2	Area 3	Area 4	Hsn 5	Sex 6	Color 7	Age 8	Age 9	M.C. 10	Ed. 11	State 12	State 13	Country 14	Country 15	Mwly 16	Imm 17	Cit. 18	Eng. 19	Occupation 20	Occupation 21	Occupation 22	Occupation 23	Class 24
1	1	1	1	No	M	W	Un	Un	Un	N Y	V	V	V	V	F	Un	Un		V	V	V	V	Un
2	2	2	2	Yes	F	Neg	100			N N	X	X	US	=	NBN	Ntv	=	No	X	X	X	X	=
3	3	3	3			Ot C	0	0			0	0	0	0	NBF	1930			0	0	0	0	E
4	4	4	4			Mex	1	1	S	Yes	1	1	1	1	NFF	'00& prior	Na	Yes	1	1	1	1	W
1	1	1	1			In	2	2	M		2	2	2	2	NMF	1901 -10	Pa		2	2	2	2	O
2	2	2	2			Ch	3	3	Wd		3	3	3	3		1911 -14	Al		3	3	3	3	
3	3	3	3			Jp	4	4	D		4	4	4	4		1915 -19			4	4	4	4	NP
4	4	4	4			Fil	5	5			5	5	5	5		1920 -24			5	5	5	5	
1	1	1	1			Hin	6	6			6	6	6	6		1925 -26			6	6	6	6	
2	2	2	2			Kor	7	7			7	7	7	7		1927			7	7	7	7	
3	3	3	3			Haw	8	8			8	8	8	8		1928			8	8	8	8	
4	4	4	4			Ot	9	9			9	9	9	9		1929			9	9	9	9	Class 24

TM 2021

The first four columns of the card are reserved for the geographic identification symbols. These symbols, which are uniform for all the cards punched for an enumeration district, are punched on what is termed a gang punch machine after the remaining columns of the card have been punched in accordance with the individual items returned for the person represented by the card.

The remaining 20 columns of the card are used for the following items:

Column 5, Farm residence, "Yes" or "No."
Column 6, Sex
Column 7, Color
Columns 8 and 9, Age
Column 10, Marital condition—single, married, widowed, or divorced.
Column 11, Illiteracy, in combination with school attendance—"No—Yes," not attending school but able to read and write; "No—No," not attending school, not able to read and write; "Yes," attending school (and assumed to be able to read and write).
Columns 12 and 13, State of birth for the native population; mother tongue for the foreign born. (While these are alternative classifications and no one individual could possibly call for both of them, the codes are devised so as to be mutually exclusive, 00 to 49 representing mother tongue and 50 to 98, State of birth).
Columns 14 and 15, Country of origin, being the country of birth for the foreign born, country of birth of father for natives of foreign parentage, and country of birth of the foreign-born parent (whether father or mother) for natives of mixed parentage.
Column 16, General nativity and parentage, as follows: Foreign born; Native, both parents native; Native, both parents foreign; Native, father foreign; Native, mother foreign.
Column 17, Year of immigration for the foreign born.
Column 18, Citizenship for the foreign born.
Column 19, Ability to speak English.
Columns 20 to 23, Occupation and industry.
Column 24, Class of worker, as follows: Employer; Wage or salary worker; Working on own account; Unpaid family worker.

The 1930 population cards were punched on hand-operated commercial punches especially constructed to fit the 24-column card. The maximum number of these punches in use at the peak of the work was 598. The cards were completely verified, 296 verifiers being used for this purpose.

Gang punch machine.—The essential feature of the gang punch is that the machine is set to punch a certain combination of holes, and punches the same combination of holes on each card until the setting

is changed. The gang punch machine used in the 1930 census has an automatic feed like a sorting or tabulating machine and punches the cards 4 at a stroke, as they run through at the rate of 448 per minute. The machine is quickly and easily reset by releasing and depressing one or more of a series of keys.

The gang punch area on the population card is divided into 12 sections or fields, each containing 4 figures; and a complete geographic code symbol, indicating State, county, city, ward or tract, if any, township or other minor civil division, and enumeration district, contains 9, 10, 11, or 12 figures.

Sorting machine.—The sorting machine used for the population cards is similar in its general plan of operation to the sorter used for commercial work. The sorting is done by columns, and one column only is sorted at a time. The Census machine is provided with a special safety device which stops the machine as soon as a card catches or starts to buckle, thus preventing the damaging of more than one or two cards.

The unit counter or population tabulating machine.—The most important machine used in the population tabulation is the unit counter, this being the machine which counts the number of persons in each area having specific characteristics, and provides the material for making up the tables for the population reports. It differs radically from the commercial tabulating machine in that it counts individual items rather than adding amounts represented by figures punched on the cards. It differs also from any of the commercial counting machines, first in its capacity for what might be termed straight counting, since it will count as many as seven separate items or fields at the same time; and still more radically in that it is provided with systems of relays whereby combinations of the fields or items can be counted without preliminary sorting of the cards. The maximum capacity of this relay device is a combination of four fields or items, though in actual practice combinations in excess of three fields are seldom used.

The general principle on which this machine operates is fundamentally different from that used in commercial machines, either counters or tabulators. In the commercial machines the response of the machine to the different positions of the holes in any column is based on the position of the card at that point in its passage through the machine when the hole in this column comes opposite a single contact point in the path of the card. The electrical impulses from the several columns in use in any run of the cards thus come at slightly different instants, the nines appreciably sooner than the ones. The Census unit counter contains for each column to be tabulated a com-

plete set of 12 brushes or contact points, one for each possible hole position; and the counting and relay devices are controlled by the position of the brush through which the electrical impulse comes. Thus the impulses from all fields in use come at the same instant—a factor which is essential to the operation of the relay system.

The results of the count are printed on a sheet which contains 60 columns arranged in six "decks" on a sheet 14 by 30 inches.

There are three limits to the amount of material which can be tabulated by this machine from one run of the cards: First, since there are only 60 counters on the machine, one of which must be used for a total, and one of which is usually used to count cards which reject for any reason, only 58 significant items can be provided for; second, there is a limit to the number of brushes which can be carried if the cards are to run satisfactorily and in large numbers, this limit being ordinarily about 72, which provides for 6 complete columns on the cards; third, the number of separate columns or fields which can be counted at one time either directly or through the use of relays is usually limited to 6, though 7 are sometimes permitted when the set-up is otherwise simple.

As an example of the relay capacity, it may be said that the machine would count marital condition by sex, color, and nativity, if this combination were desired, without sorting the cards. As a matter of fact, beginning with the second run the 1930 cards were sorted by sex, color, and nativity, these separations being maintained throughout the remainder of the runs for general population data; and the only actual use of four-column combinations in the relay system was for the agricultural occupations in the tabulation of gainful workers by industry groups, and for the combination of illiteracy, ability to speak English, and age, for the foreign born. Typical three-column combinations are age (which occupies two columns on the punch card) in combination with illiteracy and school attendance, and age in combination with marital condition or citizenship.

The nominal speed of both the sorter and the unit counter is 400 cards per minute, though with necessary delays for adjustments, readings, etc., the actual daily output ranges from 60,000 to 90,000 cards per 7-hour day, varying in accordance with the frequency of the readings or the detail of the sort.

Verification and control.—In addition to counting the items called for by the set-up, the machine may be arranged to reject certain impossible combinations of items erroneously punched on the same card—for example, a card punched "foreign-born" in one column and country of birth "U.S." in another column. The "control"

feature may also be used as a verification of the sort. For instance, the machine on which cards representing males are being tabulated may be arranged to reject any cards for females that might be accidentally included. Cards punched with code combinations that are not used—for example, a card punched "9" in a column using only positions 1 to 7—are automatically rejected.

Posting and consolidation.—As the results come from the tabulating machines they represent data for relatively small areas which must be consolidated to obtain county totals or State totals, as the case may be; and then the States must be consolidated to obtain figures for the United States as a whole. Still other consolidations are necessary in order to bring together the color-nativity classes and the males and females. Practically all of the figures on the machine sheets must therefore be transcribed to consolidation sheets and summary sheets, designed to bring together the several classes and the various geographic areas, and to provide the subtotals and totals required for the population tables. A large part of this consolidation might be made through the use of total cards punched from the unit counter machine sheets and tabulated on the adding tabulator. Such total cards were actually used for three important consolidations in connection with the 1930 census. These experiments indicated that the total card method, under favorable conditions, is both quicker and less expensive than the traditional method of hand consolidation. It is expected, therefore, that the use of total cards for this final stage of the population tabulations will be greatly extended in the next census.

A FORMULA FOR FINDING THE SKEWNESS OF THE COMBINATION OF TWO OR MORE SAMPLES.

By WILLIAM DOWELL BATEN, *University of Michigan*

Given the mean, standard deviation and skewness of two samples of n_1 and n_2 variates respectively, to find the skewness of the sample made up of the items in both of the given samples.

Let M_x, σ_x, $a_{3:x}$ represent respectively the mean, standard deviation and skewness of a sample containing n_1 variates and let M_y, σ_y, $a_{3:y}$ represent respectively these same characteristics of another sample containing n_2 variates.

By definition the skewness of a set of variates, $x_1, x_2, \ldots x_n$, is

$$(1) \qquad a_{3:x} = \frac{\mu_{3:x}}{\sigma_x^3} = \frac{\mu'_{3:x} - 3M_x\mu'_{2:x} + 2M_x^3}{\sigma_x^3};$$

where $\mu_{3:x}$ is the third moment about the mean of the set of variates and $\mu'_{2:x}$ and $\mu'_{3:x}$ are respectively the second and third moments of the set of variates. According to this definition,

$$(2) \qquad \sigma_x^3 . a_{3:x} = \frac{\sum_{i=1}^{n_1} x_i^3}{n_1} - 3M_x \cdot \frac{\sum_{i=1}^{n_1} x_i^2}{n_1} + 2M_x^3,$$

from which the sum of the cubes of the variates in the first sample is,

$$(3) \qquad \sum_{i=1}^{n_1} x_i^3 = n_1 \cdot \sigma_x^3 \cdot a_{3:x} + 3n_1 \cdot M_x\sigma_x^2 + n_1 M_x^3,$$

if it is remembered that $\sum_{i=1}^{n_1} x_i^2 = n_1 (\sigma_x^2 + M_x^2)$. In a similar manner it can be shown that the sum of the cubes of the variates in the second sample is

$$(4) \qquad \sum_{j=1}^{n_2} y_j^3 = n_2\sigma_y^3 \cdot a_{3:y} + 3n_2 M_y\sigma_y^2 + n_2 M_y^3.$$

The skewness of the entire set of variates in both samples is by definition

$$(5) \quad a_{3;x+y} = \frac{\mu_{3;x+y}}{\sigma^3_{x+y}} = \frac{\mu'_{3;x+y} - 3M_{x+y} \cdot \mu'_{2;x+y} + 2M^3_{x+y}}{\sigma^3_{x+y}},$$

where $\mu_{3:x+y}$, σ_{x+y}, *and* M_{x+y} represent respectively the third moment about the mean, the standard deviation and the mean of the entire set of variates, while $\mu'_{2:x+y}$ and $\mu'_{3:x+y}$ represent respectively the second and third moments of the entire set of variates. The right member of (5) may be written as follows:

$$(6) \quad a_{3;x+y} = \frac{\dfrac{\sum_{i=1}^{n_1} x_i^3 + \sum_{j=1}^{n_2} y_j^3}{n_1+n_2} - 3M_{x+y}\left(\sigma^2_{x+y} + M^2_{x+y}\right) + 2M^3_{x+y}}{\sigma^3_{x+y}}.$$

Substituting the values of the sum of the cubes as found in (3) and (4) into (6) gives

$$(7) \quad a_{3;x+y} = \frac{1}{\sigma^3_{x+y}} \left\{ \frac{n_1[\sigma^3_x a_{3;x} + 3M_x \cdot \sigma_x^2 + M_x^3] + n_2[\sigma_y^3 \cdot a_{3;y} + 3M_y \cdot \sigma_y^2 + M_y^3]}{n_1+n_2} - 3M_{x+y}\,\sigma^2_{x+y} - M^3_{x+y} \right\} = \frac{A\text{-}B\text{-}C}{\sigma^2_{x+y}}$$

Where A is equal to the fraction in the braces, $B = 3M_{x+y} \cdot \sigma^2_{x+y}$ and $C = M^3_{x+y}$.

It is easy to show that the mean of the items in both samples is

$$(8) \quad M_{x+y} = \frac{n_1 M_x + n_2 M_y}{n_1 + n_2},$$

and that the standard deviation of the items in both samples is

$$(9) \quad \sigma_{x+y} = \sqrt{\frac{n_1(\sigma_x^2 + M_x^2) + n_2(\sigma_y^2 + M_y^2)}{n_1 + n_2} - M^2_{x+y}}.$$

Substituting (8) and (9) into (7) gives

$$(10) \quad a_{3;x+y} = \{ (n_1+n_2)^2 [n_1\sigma_x^3 \cdot a_{3;x} + n_2\sigma_y^3 \cdot a_{3;y} + 3(n_1 M_x \sigma_x^2 + n_2 M_y \sigma_y^2) + (n_1 M_x^3 + n_2 M_y^3)]$$

$$- 3(n_1 + n_2)\,(n_1M_x + n_2M_y)[n_1(\sigma_x^2 + M_x^2) + n_2(\sigma_y^2 + M_y^2)]$$
$$+ 2(n_1M_x + n_2M_y)^3\}\,\{(n_1 + n_2)[n_1(\sigma_x^2 + M_x^2)$$
$$+ n_2(\sigma_y^2 + M_y^2)] - (n_1M_x + n_2M_y)^2\}^{-3/2}$$

which expresses the skewness of a sample made up of the variates in both samples in terms of n_1, M_x, σ_x, $\alpha_{3:x}$, n_2, M_y, σ_y, $\alpha_{3:y}$, the numbers of variates in the samples, means, standard deviations and skewness of the respective samples.

In general the skewness for the sum of the items in S samples is

$$(11)\quad \alpha_{3:x_1 + x_2 + \cdots x_s} = \left\{ \left(\sum_{i=1}^{S} n_i\right)^2 \left[\sum_{i=1}^{S} n_i\sigma^3{}_{x_i}\alpha_{3:x_i} + 3\sum_{i=1}^{S} n_iM_{x_i}\sigma^2{}_{x_i} + \sum_{i=1}^{S} n_iM_{x_i}^3 \right] - 3\sum_{i=1}^{S} n_i \cdot \sum_{i=1}^{S} n_iM_{x_i} \cdot \sum_{i=1}^{S} n_i(\sigma_{x_i}^2 + M_{x_i}^2) + 2\left[\sum_{i=1}^{S} n_iM_{x_i}\right]^3 \right\}$$
$$\left\{ \sum_{i=1}^{S} n_i \cdot \sum_{i=1}^{S} n_i(\sigma_{x_i}^2 + M_{x_i}^2) - \left(\sum_{i=1}^{S} n_iM_{x_i}\right)^2 \right\}^{-3/2},$$

where n_i, M_{x_i}, σ_{x_i}, $\alpha_{3:x_i}$, are the numbers of items, the mean, the standard deviation and skewness respectively of the ith sample.

Formula (7) is the best for computing the skewness. The best method for obtaining the skewness for the sum of the items in two samples is as follows:

Find the mean of the entire set of variates in both samples by the formula (8); also the standard deviation of the combined set of variates by formula (9). Find the value of A and then substitute in (7) for the value of $\alpha_{3:x+y}$.

The following example will show the use of formula (7) and also how to carry out the computations.

The following characteristics were found for the distributions of weights of first year male students at a certain university for two years.

For first class		For second class	
n_1 =	718.00 ;	n_2 =	1,000.
M_x =	139.55 lbs. ;	M_y =	138.65 lbs.
σ_x =	17.75 lbs. ;	σ_y =	18.03 lbs.
$\alpha_{3:x}$ =	.78 ;	$\alpha_{3:y}$ =	.94.

To find the mean, standard deviation and skewness of the distribution made up of the weights of the men in the two classes:

Computations

		x	y	Weighted arithmetic average
Given	n =	718.	1,000.	
	M =	139.55,	138.65,	$139.03 = M_{x+y}$,
	σ =	17.75,	18.03,	
	a_3 =	.78,	.94.	
	$\sigma^2 + M^2$ =	19,789.26,	19,548.90,	$19,649.35 = R$
	$\sigma^3 a_3 + 3M\sigma^2 + M^3$ =	2,853,887.78,	2,806,109.62,	$2,826,077.44 = A$,

$$\sigma^2_{x+y} = R - M^2_{x+y} = 320.01,$$

$$\sigma_{x+y} = 17.8888,$$

$$B = 3M_{x+y} \cdot \sigma^2_{x+y} = 133,472.97,$$

$$C = M^3_{x+y} = 2,687,358.14,$$

$$B + C = 2,820,831.11,$$

$$a_{3:x+y} = \frac{A - (B+C)}{\sigma^3_{x+y}} = \frac{5,246.33}{5,724.59} = .92.$$

Hence

$$M_{x+y} = 139.03 \text{ lbs.};$$
$$\sigma_{x+y} = 17.89 \text{ lbs.};$$
$$a_{3:x+y} = .92.$$

Some of the members need not be written if one has access to a computing machine.

Formulas (8), (9) and (10) enable one to combine the results obtained from two sets of data without going back to the original measurements.

SHOULD A FEDERAL MONETARY AUTHORITY BE ESTABLISHED TO EXERCISE COMPLETE CONTROL OVER THE CURRENCY?

A luncheon meeting of the American Statistical Association was held on Wednesday, October 17th, 1934, at the Savarin Restaurant, 120 Broadway, New York City. Dr. Ernest S. Bradford of the Department of Economics of the College of the City of New York presided. The topic for discussion was *"Should a Federal Monetary Authority be Established to Exercise Complete Control Over the Currency?"*

Frank A. Vanderlip, former president of the National City Bank, spoke in advocacy of the establishment of such an authority. He contended that it is not feasible to return to a gold standard which fixes rigidly the weight of the dollar and calls for free redemption of paper money in gold on demand. Such a return is impracticable because of the large amount of international indebtedness which makes it possible, on short notice, to call very large quantities of gold from one country to another.

Mr. Vanderlip advocated a Monetary Authority which would take over from the Government and the Federal Reserve Banks all gold reserves—issuing its notes in exchange therefor. The Authority would neither receive deposits nor lend money, but would rediscount commercial paper held by Federal Reserve Banks and would buy and sell short-term paper, bankers' acceptances, and foreign exchange in the open market. It would, at all times, maintain such reserves of gold and silver as were found necessary, and would consistently maintain a free market for these precious metals. The Authority would engage in open-market operations. Centralization of this power would avoid the difficulties now existing because of the independent action of the various Federal Reserve Banks. The Monetary Authority would interfere in no way with the chief existing function of the Federal Reserve Banks—namely that of accommodating the needs of business and industry. The prime duty of the Monetary Authority would be to maintain a stable price level—something which the Federal Reserve Banks have not done in the past.

Professor Walter E. Spahr of the Economics Department of the School of Commerce, Accounts, and Finance of New York University opposed the establishment of a Federal Monetary Authority. He held that such an Authority could do nothing which the Federal Reserve Banks cannot now do, and that it would be most unwise to strip a well established institution like the Federal Reserve System of some of its most essential functions and transfer these to a new organization. He contended that the Monetary Authority would be dominated by the fiscal authorities of the Federal Government and would quickly become a football of politics. No matter what powers were given to the Monetary Authority, it could not actually keep the price level stable in time of war. Unless the present system of reserves was radically changed, it could not hope to keep the price level stable in time of peace. One difficulty would be that the effects of its efforts would not be felt

for some time. Furthermore, the lag would be increased by the fact that it would take time to gather the statistics which the Monetary Authority would necessarily require as a guide. At a critical time like the present, any "tinkering" with our monetary and banking system is extremely unwise.

Mr. Vanderlip replied to Professor Spahr's argument by stating that the Monetary Authority would be entirely divorced from the Treasury Department. To free it from political influence, the plan is to have the commission composed entirely of experts, and appointed by the President for life. Mr. Vanderlip thought that it is inexcusable to refer to a carefully planned process of reform as "tinkering". When the Federal Reserve System was established, objections were raised on the ground that we were "tinkering" with the banking system of the country. The gold standard has proved so unsatisfactory that it is essential that something be done to maintain, in the future, a stable price level.

Professor Spahr replied that despite any regulation the appointees to the Monetary Authority would probably be incompetent politicians of the radical type. He held that the World War, and not the gold standard, is to blame for the untoward conditions which have existed recently. We ought to re-establish immediately a gold bullion standard with the dollar having a fixed weight. With irredeemable paper money it is impossible to maintain a suitable price level after the populace find out that there is no intention to redeem the paper money in gold at a later date. Standardization of the price level is desirable, but it should be undertaken only when the entire economic system is in a state of equilibrium. Such a state exists when unemployment is at a minimum and goods are exchanging freely, and when prices of various commodities are in their normal relationships. Such conditions have not existed at any time since the World War. Professor Spahr declined to name any date before the World War at which economic equilibrium prevailed.

Mr. Vanderlip expressed doubt that it would be possible, at any given time, to determine whether or not the economic system was in equilibrium.

In reply to a question, Professor Spahr stated that there may be a difference between the function of stablizing the price level and the function of accommodating business and industry with credit. He held, however, that the exercising of the latter function would be almost certain to interfere with price level stabilization.

WILLFORD I. KING, *Secretary*

EMPLOYMENT AND HEALTH

A dinner meeting of the American Statistical Association was held on January 25, 1935 at the Hotel Delano, 108 West 43rd Street, New York City. Forty-six persons attended. Dr. Willford I. King, President of the Association, presided. The general topic of the meeting was Employment and Health.

The first speaker was Dr. Selwyn D. Collins of the United States Public

Health Service who reported on the study of Sickness in Wage-Earner's families in Ten Surveyed Cities which was conducted jointly by the United States Public Health Service and the Milbank Memorial Fund. Dr. Collins started by stating that the recent decline in the death rate did not necessarily reflect the health of the unemployed who bore the brunt of the depression. In each of the ten cities included in the study, an area was selected in the poorer sections (but not in the slums) with no attempt to select an area representative of the city as a whole. Every house in the selected district was canvassed and detailed information was secured on illnesses during the period of the study. In addition, family income data was obtained for each year from 1929 to 1933, inclusive. In the analysis, comparisons were made between those families which had suffered severe reductions in income and those which had not. When adjustments have been made for age differences, families with no workers gainfully employed showed higher rates of disabling illness than families with workers employed. Similar differences were found in the standardized death rates of the two groups and in several sub-classifications of illness.

George St. J. Perrott of the Federal Emergency Relief Administration discussed the Extent of Disability in the Relief Population. A preliminary analysis of an occupational characteristic survey conducted in eighty cities reported higher proportions of handicapped individuals among persons between sixteen and sixty-four years of age who were seeking work than among persons of similar age who were working. The proportions were several times as great for persons who were not seeking work and were greater for males than for females. In general the proportion increased with age at a geometric rate. On the basis of more intensive studies in Massachusetts, tentative estimates were made of the proportion of persons of working age totally disabled and the proportion partially disabled. The surveyed results are being evaluated by comparison with medical tests which are now being conducted.

Dorothy G. Wiehl of the Milbank Memorial Fund discussed Diets of Low Income Families During the Depression. A sample of one hundred families was studied in each of eight communities and two hundred seventy-six families were studied in New York City. In New York City and in five Northern cities the lower income families averaged twenty per cent below the standard of a "fully adequate" diet. In the Southern communities all income groups were above this standard, principally due to the high proportion of fats in their diets. Relief families in the Northern cities and New York City showed roughly half this deficiency with work relief families in New York City exhibiting a deficiency of approximately eighteen per cent in comparison with seven per cent for home relief families. Interesting excesses and deficiencies were found for different types of foods both in high income and low income families. Milk was the most serious deficiency, especially in the lowest income families and in Southern communities.

A study of the Growth of Children During the Depression was reported by Dr. Carroll E. Palmer. After noting wide-spread skepticism as to an increase

in malnutrition during the depression and the lack of an adequate standard for comparing the growth of children during the depression with children in pre-depression years, Dr. Palmer reported a study in Hagerstown, Maryland conducted by the United States Public Health Service and involving approximately 10,000 measurements, over a period of seven years, of children between six and fourteen years of age. While no great differences were revealed from year to year in average weights of children of specified age, an analysis of the year to year gains of identical individuals showed definite cycles. Thus 1921–22 and 1926–27 were good growing years while 1924–25 and 1933–34 were relatively poor growing years. It was concluded, on the basis of these data, that at least in some localities there is no evidence of an increase in malnutrition in children during the depression.

The four discussions were illustrated by slides and included a large amount of detailed data which cannot be presented in this brief résumé.

FREDERICK F. STEPHAN, *Secretary*

A CORRECTION

The Editor, JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION:

Dear Sir:

In the September, 1932 issue of this JOURNAL the writer published an article entitled "A General Method for Evaluating Multiple Regression Constants." Equation (5), which gives the multiple regression coefficient as a function of the co-factors of the determinant of a zero order correlation coefficient, is incorrect. As published the equation reads:

$$\beta_{1j\,.\,12\,..\,(\,)\,..\,(\,)\,..\,n} = \frac{R_{1j}}{R_{11}}$$

The correct formula is: $\beta_{1j\,.\,12\,..\,(\,)\,..\,(\,)\,..\,n} = \dfrac{-R_{1j}}{R_{11}}$

Sincerely yours,

PAUL HORST

DEVELOPMENT OF THE ACTIVITIES OF THE AMERICAN STATISTICAL ASSOCIATION

During the last ten years, the American Statistical Association doubled its membership and expanded and improved both its publications and its other activities. The Association's progress has been an expression of the efforts of past and present officers, directors, committee members, district secretaries, and many other active members. The leadership of Willford I. King, as Secretary-Treasurer, and Frank A. Ross, as Editor, has been especially significant in making these efforts effective.

The offices of Secretary and Editor, left vacant by the resignation of Dr. Ross and the election of Dr. King to the Presidency, have been combined for 1935 as an experiment in the administration of the affairs of the American Statistical Association. As part of the experiment, the offices of the Association were moved to Washington, D. C., in January. The move was ordered by the Board of Directors to explore the possibilities of (1) closer contacts with other scientific societies, (2) continuing some of the advisory functions which the Association has performed through various committees in recent years, and (3) maintaining on a relatively small scale a critical examination of the statistical work of the Federal Government and of other governmental and private agencies.

This program does not involve any radical changes in the organization or activities of the Association and it is not intended to diminish the close contact with business statistics and statisticians which the Association has enjoyed in the past in New York and other cities. In includes activities designed to aid and strengthen the Chapters and to increase the service of the Association to its members.

The Rockefeller Foundation has granted $7500 for the year 1935 to assist the Association in the development of its activities.

FREDERICK F. STEPHAN, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

CENSUS OF AGRICULTURE

Before this issue of the JOURNAL is printed the field work on the census of agriculture will have been completed. By the end of December all the 227 supervisors had been appointed and also a large proportion of the 25,200 enumerators; and the canvass had already been begun in some sections of the country. The campaign of education undertaken to inform the farmers and the general public about the census and awaken their interest in it has been more extensive and thorough-going than in any previous census. Nearly 1,400,000 sample schedules have been distributed to farmers, county agents, postmasters, and agricultural societies. The Bureau has also sent out about 700,000 advertising cards, and 50,000 posters to be displayed in local post-offices or other public places, as well as large numbers of pamphlets and press releases.

CENSUS OF INSTITUTIONS

The tabulation of the data for the decennial census of institutions, covering the calendar year 1933, is completed and the manuscript or copy for the final reports has been sent to the printer. By the time this issue of the JOURNAL is published the reports, it is expected, will be all printed or in type. The inquiry this time did not include paupers in almshouses or inmates in institutions for the care of adults, but otherwise its scope is substantially the same as that of the institutional census of 1923. It includes prisoners, juvenile

delinquents, the insane, feeble-minded and epileptic, and children in institutions or under supervision of child-placing agencies.

JUDICIAL CRIMINAL STATISTICS

In March, 1931, an Act was passed authorizing the Director of the Census "to compile and publish annually statistics relating to crime and to the defective, dependent, and delinquent classes." Prior to that time the authority to compile statistics of this character, so far as explicitly conferred by statute, was limited to decennial inquiries, although annual compilations of statistics relating to prisoners in State and federal prisons and to the insane in State institutions had been instituted in 1926 by order of the Secretary of Commerce acting under a general provision of the law organizing the Department of Commerce.

Under authority of the act of 1931 these annual inquiries are being continued and at the same time the Bureau has inaugurated an annual compilation of judicial criminal statistics.

The scope and general character of this compilation were largely determined on the basis of studies or surveys in the field of judicial criminal statistics that had been conducted by L. C. Marshall and others and sponsored by the Institute of Law of the Johns Hopkins University. These studies (Marshall refers to them as "forays into an almost unexplored territory"), conducted first in the state of Ohio in 1930 and extended in 1931 to cover five other states, proved illuminative and valuable in showing that it was practicable and safe for the Bureau to undertake as regards both the courts that might be covered and the class of data that might be obtained.

The collection of data made by the Bureau of the Census for 1932 covered 15 States and the District of Columbia. That for 1933 covered 30 States, though it is by no means certain that the returns from all these states will be sufficiently complete for tabulation.

The statistics collected relate to the disposition of criminal cases definitely before trial courts of general criminal jurisdiction. The court of general criminal jurisdiction is the principal court for the trial of felonies. It also tries considerable numbers of misdemeanors; but usually the less serious offenses—which far outnumber the felonies—are tried by the minor courts.

The data are of two classes: (1) those relating to procedural outcome of all cases before the courts, and (2) those relating to sentence or treatment of defendants found guilty. The tabulation of the former distinguishes conviction by jury, conviction by court (jury being waived), plea of guilty, dismissal by the prosecution, dismissal by court on motion of defense, acquittal by jury, acquittal by court (jury being waived), other disposition. The tabulation with respect to sentence or treatment of defendants found guilty distinguishes prison or reformatory sentence, jail sentence, sentence to juvenile reformatory, money payment only, probation or suspended sentence, death penalty, and "other." It shows also whether the prison, jail, or probation sentence includes a fine or other payment; whether the probation or suspended sentence includes supervision; and whether the money payment

when that is the sole penalty consists of a fine either with or without other money payment, or of costs only, or of restitution or support order either with or without other costs. All these classifications are correlated with a summary classification by the offense with which the defendant is charged or of which he is found guilty. There is no classification by duration or character of prison or jail sentence or by amount of fine.

The results of this limited inquiry, which is, obviously, a mere beginning in the field to which it relates, have been published for the year 1932 on rota-printed sheets. The data for 1933 have been collected and are now being tabulated.

BIRTH REGISTRATION CAMPAIGN

The Bureau of the Census, with the aid of workers on the payroll of the F.E.R.A., is carrying on a campaign which has for its primary purpose the education of the public regarding the importance of birth registration. Although it involves the post-card check customarily employed by the Bureau, the testing aspect is emphasized only as it relates to intra-state comparisons, the state health authorities being given to understand that there is no thought of checking their eligibility to remain in the registration area, that the purpose, on the contrary, is to assist them in securing the best possible registration within their state.

Post cards on which to report any birth occurring within the last year are sent out to postmasters and letter carriers for distribution to families throughout the State. The cards are mailed under frank to the Census Bureau, which forwards them to the State registrars, where the work relief personnel checks them to the official State records of births.

Campaigns in the following states have been conducted or provided for in the order here given: Georgia, West Virginia, Vermont, New Hampshire, Mississippi, Arkansas, Oklahoma, Missouri, Kansas, Iowa, South Dakota, North Dakota, Montana, Wyoming, Colorado, Utah, Idaho, Washington, Oregon, California, Nevada, and North Carolina. Other states may be added to the campaign plans in 1935.

In each state there is a publicity director on the F.E.R.A. payroll, while the Census Bureau provides field representatives, each of whom supervises the checking in from one to three or four states.

One of the incidental benefits of the campaign is that it establishes a direct contact between the Bureau and the state authorities, such as has not always existed heretofore. Another is that it furnishes material for a study of effective methods of promoting birth registration; and also for a study of the problem of securing an accurate check on birth registration. It is expected that a monograph or report will be prepared on each of these subjects.

In connection with this campaign it developed that a number of states have no adequate indexing of births and deaths, so that searches, if made at all, depend on certificates or journal entries arranged in chronological order. The Census Bureau has it in mind to select or devise a standard indexing pro-

cedure which may be recommended to those states which desire to introduce a system of indexing or to improve one already in use.

J. A. H.

MISCELLANEOUS NOTES

Organization of a Chapter in New York City.—At the meeting of the American Statistical Association in New York City on January 25, 1935, President Willford I. King reported that the Board of Directors of the Association had authorized him to take the necessary steps to establish a Chapter of the Association in New York City, if the members of the Association residing in and near New York so desired. A motion was carried resolving that a Chapter be formed and instructing the President to appoint a committee to make the necessary preparations for organizing a Chapter. The President explained the procedure of forming Chapters in other cities and the members who were present discussed the choice of a name for the Chapter, the possible methods of meeting the expenses incident to the meetings, and a number of other details to be referred to the organizing committee.

Consolidation of Office of Secretary-Treasurer and Editor.—The responsibilities of Secretary-Treasurer of the American Statistical Association and Editor of the JOURNAL have been vested in one individual, Mr. Frederick F. Stephan, and the office of the Association is now located at 722 Woodward Building, Washington, D. C. Mr. Stephan was formerly a member of the faculty of the University of Pittsburgh and more recently has been coordinator of state statistical projects submitted to the Federal Emergency Relief Administration. He assumed his new office with the Association on January 1, 1935. The current issue of the PROCEEDINGS appears under his editorship while the March issue of the JOURNAL has been supervised by the Acting Editor. In taking leave after his brief incumbency, the Acting Editor wishes to thank the many members of the Association whose papers, reviews, and criticisms have made it possible to seek the attainment of a continuing high standard.

Mr. Ralph J. Watkins continues as Review Editor and all correspondence relating to reviews should be directed to him.

The Boston Chapter.—The eighth annual meeting of the Boston Chapter was held at the Boston City Club on Monday evening, December 3, 1934. There were 26 members and guests present. The following officers were elected for the ensuing year: President, Howard C. Baldwin, Babson's Statistical Organization; Vice President, T. Frederick Brunton, Assistant Actuary, John Hancock Mutual Life Insurance Company; Secretary-Treasurer, Roswell F. Phelps, Director of Statistics, Massachusetts Department of Labor and Industries; Counsellors, Professor D. S. Tucker, Massachusetts Institute of Technology and Paul T. Babson, President, United States Business Service. The two papers presented at the meeting were "Public Expenditures and Inflation" by Professor Seymour E. Harris of Harvard University and "The Consumption of Capital in Austria" by Dr. Fritz Machlup.

Professor Harris pointed out that exchange depreciation, which had been expected to result in an advance in the domestic prices, could on the other hand result in the establishment of a new international price equilibrium through a decline in

foreign prices. A somewhat different set of consequences might follow from such a policy as adopted by the A.A.A. with reference to a commodity like cotton. In this case it is possible for the policy to result in an actual advance in the world price of the particular commodity. There has been a large increase in bank deposits attributed partly to the influx of gold (which resulted from the gold buying and devaluation policy), partly to the reopening of certain banks and partly to some actual expansion. It was observed that the banks had not invested the nearly two billion excess reserves in government securities, and this may reflect a lack of faith in such securities. It is even possible that a drop in the price of government securities would bring considerable liquidation by the banks. Developments of this sort would lead almost automatically to inflationary action. Such action might be postponed by the placing of great emphasis on short-term government financing.

It was observed that in this way governmental expenditures have gone largely to financing losses. This applies not only to direct governmental expenditures but also those made by certain quasi-governmental organizations. An important point to bear in mind about governmental expenditure is that it may be directed largely to the creation of non-productive goods. The importance of this, not only upon the course of the various banking figures but also upon the expansion of activities and employment, needs to be traced out. The existing money situation is such that the easiest way out for the banks is to facilitate the maintenance of the existing wage scale while output declines—with a consequent probable rise in prices. A marked rise in prices is probable if government expenditures (under the existing money set-up) cause an increase in total expenditure, and such a rise is likely, even if the government makes merely a larger proportion of total expenditure.

Dr. Machlup's estimates of consumption of capital in Austria rests primarily on a market valuation of reassessed capital assets at two dates, 1913 and 1930. To the 1913 figure as tabulated certain additions are made to allow for the accumulation of capital in two intervals, one before 1922 and the other since 1922. The resulting adjusted 1913 figure is compared with the 1930 figure and the discrepancy is regarded as a measure of the consumption of capital. Taking Austrian corporations as a whole the 1930 figure is only 21% of the adjusted 1913 figure. The loss in capital resulted partly from changes in demand, which would bring about some impairment of capital. Such changes are brought about largely as a result of the policy of nationalism; but the loss of capital is mainly a result of several other causes. The speaker listed as such causes: miscalculation due to inflation, over-taxation of incomes, over-taxation of production, forcing up wages, forcing up social benefits, paying unearned dividends, keeping industries going.

The Chicago Chapter.—The first dinner meeting of the Chicago Chapter for the year 1934–35 was held at the Auditorium Hotel, November 7, 1934, with seventy-one members and guests present.

A. C. Hodge of Sheridan-Farwell and Morrison, Inc. spoke on "The Securities Exchange Act of 1934 and Control of Credit Extension by the Federal Reserve Board". Mr. Hodge represented the Chicago Federal Reserve Bank in the framing by the Federal Reserve Board of Regulation "T", relating to the extension of credit for stock purchases under the Act. He summarized the provisions of the Act, the technique of their application, and the meaning of the various

new terms arising from the Act and Regulation "T", and commented on the effects of the regulation of securities exchanges. Regulation "T", he explained, is the method by which the Federal Reserve Board acts to limit the credit flowing into the stock market, thus preventing such maladjustments as the "boom" in 1929. In the speaker's opinion, the Act will limit speculation, will cause the customers' interest to be more nearly of an investment character, and lead to an increase in the use of investment analysts and counsellors.

Harland Allen of Harland Allen Associates discussed "The Prospect of Securities Prices in the Light of Current Economic Trends". He mentioned that there were four major influences affecting the underlying trend of prices; namely, psychological factors, the value of the dollar, the general health of industry, and the trend of world prices and competitive conditions. The value of the dollar is of little importance as an immediate consideration; if the dollar be further devalued, it will carry commodity prices in the opposite direction with a favorable effect on the health of industry for a time. In determining the trend of security prices, one cannot depend much any more on the former "barometers" and their leads and lags. Car loadings, for example, are no longer significant or dependable due to such influences as shipments of government purchases of drouth cattle. The former relationship of bank deposits and bank loans to business recovery has been disrupted. The analyst must, therefore, go deeper to forces such as industrial health and world price conditions. The dislocation of the ratio between investment and consumer purchasing, which was one of the major causes of the depression, is at present an influence tending to prevent recovery. The speaker pointed out that the trend of commodity prices is one of the truest tests of the vigor of purchasing power within a nation, and that prices do not yet show the cue for a bull market.

Officers of the Chicago Chapter for the current year are: President, Garfield V. Cox of the School of Business Administration of the University of Chicago, Vice-President, John Boatwright, Statistician, Standard Oil Co. of Indiana; Secretary and Treasurer, Ray D. Kinkaid of the Illinois Bell Telephone Co.; and Directors, J. J. Gilbert of Mandel Brothers, C. A. R. Wardwell of Northwestern University, and P. R. Kerschbaum of the Illinois Department of Labor. These officers were elected at the annual meeting held May 24, 1934 which was attended by 63 members. The program was a symposium on the outlook for prices. The speakers were: W. B. Lawrence, director of the cost accounting and statistical department of the American Photo Engravers Association, who discussed "The Effect of Codes Upon Costs and Prices"; John H. Cover, Professor of Statistics, University of Chicago, and director of the retail price analysis project, whose subject was "The Consumer and the Price Boomerang"; John W. Boatwright, Statistician, Standard Oil Co. of Indiana, who spoke on "Prices in the Gasoline and Oil Industry"; E. J. Fowler, Statistician, Commonwealth Edison Co., who talked on "Public Utility Rates"; Nat C. Murray, Statistician, Clement Curtis & Co., who discussed "Grain Prices"; and S. W. Russell of the Commercial Research Department of Swift & Co., whose discussion was on "Prices of Hogs, Poultry, and Eggs".

The Chicago Chapter heard a discussion on December 10 of "The Labor Board and Labor Unrest" by Dean W. H. Spencer of the School of Business, University of Chicago. Dean Spencer, who is also Chairman of the Chicago Regional Labor Board, discussed the position in which labor found itself before the Labor Board was established, problems that have arisen in connection with interpreting and

applying Section 7-a of the NIRA, other problems growing out of the conflicting views of employers and employees, and the type of control government may be expected to continue to exercise over the relations between employers and employees.

The Cleveland Chapter.—The second meeting of the Business Statistics Section of the local Chapter was held at the Hotel Carter on November 13. The meeting was addressed by Russell Weisman, a columnist on business and finance for *The Cleveland Plain Dealer*. Mr. Weisman spoke on "Inflation" and after a few introductory remarks on the history of inflationary movements, the speaker discussed the prospects for monetary and credit inflation during the near future.

The third meeting of the Section was held on December 10. John Love, a columnist for *The Cleveland Press* on "Today's Business" announced as his subject, "The Anatomy of Pessimism" or "The Menace of Inflation in a Democratic Form of Government under Capitalism". The meetings this fall have been very well attended.

The Connecticut Chapter.—At a dinner meeting on November 27, Professor C. J. Tilden of Yale presented a paper outlining some of the preliminary results of a recently completed survey of "Vehicle Speeds on Connecticut Highways". The Chapter has just organized a Business Section with Louis M. Nichols of the General Electric Supply Corporation (Bridgeport) and L. G. Flick of the International Business Machines Corporation (New Haven) on the Directing Committee. The Business Section had its first independent meeting on December 13. A general discussion of the current business situation followed the dinner.

The Pittsburgh Chapter.—"Corporation Reorganization under the Recent Amendment to the Bankruptcy Act," was the subject of the October meeting of the local chapter, held at the Harvard-Yale-Princeton Club on October 25. Maynard Teall, of the law firm of Reed, Smith, Shaw, and McClay, was the principal speaker.

In November the local chapter joined with the Pittsburgh Personnel Association at a dinner meeting at the Harvard-Princeton-Yale Club. H. M. Gartley of H. M. Gartley, Inc., New York City, was the speaker, his subject being "The Technical Side of the Stock Market." Mr. Gartley, an outstanding authority on stock price trends, is an associate lecturer at Columbia University and at New York University. There was no regular meeting of the local chapter in December, because members were invited to attend the annual meetings of the American Association for the Advancement of Science, which were held in Pittsburgh from December 27 to January 2.

The San Francisco Chapter.—Professor Albert H. Mowbray was the speaker at the December 5 meeting of the local chapter. His subject was "Some Aspects of Unemployment Insurance". The subject was ably discussed and included such aspects as risks, benefits, and types of unemployment insurance. A dinner meeting was held on January 24 at the Bellevue Hotel. Professor M. R. Benedict of the University of California led the discussion on, "Decentralization vs. Centralization in the Collecting and Interpreting of Statistical Data".

The risk of unemployment, Professor Mowbray pointed out, is unlike other risks successfully handled by insurance, whether by public or private carrier, in that the individual risks are not isolated and concentration of losses (in the

depression phase of the cycle) is unavoidable. Moreover, at least two types of unemployment are unpredictable in their incidence and duration—the technological and cyclic—and yet are the types creating the most suffering and most necessary to be dealt with. In the ordinary sense, unemployment insurance is impossible. It is, however, possible to accumulate a fund in prosperous times from which to pay indemnities for a limited duration while the fund lasts, perhaps through the whole period of a minor depression and fairly well into a major one. But, at least with our present limited knowledge, we can hardly hope to avoid the need, during a major depression, of relief based on need, either in the form of direct relief or a special work program. He discussed in detail some of the principal problems involved in constructing a just and workable insurance policy.

National Resources Board.—Among the recommendations made by the National Resources Board in a report to the President on December 14, 1934 were the following: (1) That a financial balance sheet for the Federal Government should be set up and maintained by the Comptroller General and that provision be made to make available to Federal agencies adequate similar statistics concerning States and municipalities; (2) that a mid-decennial census of population and employment be taken during the next year, and that techniques be developed for reliable estimates of population and employment for the periods between the years when the Census is taken; (3) that standard maps of the United States be pushed to completion within ten years as a Federal project with initial appropriations at the rate of fifteen million dollars annually; (4) that assistance be provided for basic studies relating to water and land resources, including climatology, soil erosion, soil classification and ground water, and that gauging stations on rivers and other recording operations be extended to cover the principal streams of the country.

Bureau of Agricultural Economics.—The Bureau of Agricultural Economics is preparing estimates of income from farm marketings monthly, by states, from January 1929 to date. The estimates from January 1932 will be available in the near future and those for the years 1929 to 1931 will be available in the next few months. Monthly releases will be prepared in the future to keep the series of income estimates up to date. These income estimates are of special importance at the present time as the marked reduction in crop production and the heavy emergency sales of livestock have greatly affected the income in the different states and will have a marked effect on income for several months to come.

A series of eight special reports on prices paid by farmers as of January 24–27, 1934 has been released by the Division of Crop and Livestock Estimates. This series shows average prices of a comprehensive list of more than 200 different articles bought by farmers, by states, as well as information on the kind of articles bought and quantities of given food products usually purchased at one time. The reports are based on the results of a four-day enumeration conducted by Federal Civil Works Administration employees under the supervision of officials of the Bureau of Agricultural Economics. A representative sample of 112,514 establishments selling clothing, food, household articles, furniture, floor coverings, building materials, fencing materials, fuel, equipment, supplies, machinery, feed, seed and fertilizer to farmers were canvassed in towns of 15,000 population or under, in 2,862 agricultural counties of the country. Prices were enumerated on

kinds of articles most commonly purchased by farmers. This factor contributes to the geographic variation shown by the data.

This material is proving of immense value to the Division of Crop and Livestock Estimates in improving its work of collecting current information on prices farmers pay. Most important of all, it has provided a base from which actual as well as relative changes in prices can be measured. In addition, an analysis of the data will indicate the approximate standards of accuracy that can be attained by the voluntary sampling method, while the information on kinds of articles bought will enable the Division to re-word its questionnaires, cut down the dispersion in its price samples, and thereby facilitate the attainment of these standards of accuracy. These analyses are now nearing completion and a final report on the project, that should be of interest to everyone concerned with prices paid by farmers and the methodology of price collection, will be issued within the new few months.

During the past season the Division of Agricultural Finance has completed a study of farm mortgage delinquency based upon reports from 12,000 farmers having mortgages on their farms. The results indicate that forty-five percent of all mortgaged properties and fifty-two percent of the amount of the debt were in arrears for non-payment of interest or principal January 1, 1934. These data indicate the delinquency status of farm mortgages prior to the commencement of operation of the Farm Credit Administration. The report, summarized in *The Agricultural Situation* for December 1934, states that it is believed that conditions have since been much improved by the increased farm income and the extensive refunding operations of Federal agencies.

Bureau of Labor Statistics, United States Department of Labor.—The principal new undertaking of the bureau during recent weeks was the survey of annual earnings and regularity of work in the automobile industry. This survey, made in cooperation with the N.R.A., was the result of a request by the President, who in approving the extension of the automobile code to February 1, 1935, stated that he would have an investigation made as to the possibility of regularizing employment and income in the manufacture of automobiles. This survey included a study of wages and hours of labor, similar to the earlier wage studies of the bureau for this industry.

The wage and occupational survey of the various branches of the textile industry, initiated in October as a result of the Winant Board report, was completed late in the year.

A joint investigation of labor conditions in the onion fields of Ohio, by the Department of Labor, the Department of Agriculture, and the Federal Emergency Relief Administration, was completed and a report submitted in December. This investigation was an outcome of the serious industrial disturbances which occurred in the Ohio onion-growing area last summer.

The study of salaries and working conditions of newspaper editorial and reporting staffs is ready for publication, and a study of wages and hours of labor in bakeries is in progress. Also in progress is an investigation covering the shifting status and earnings in the engineering profession.

Beginning in September 1933, the Bureau of Labor Statistics began the publication of a monthly journal entitled "Labor Information Bulletin." This publication attempts to present very brief summaries of current labor and economic conditions, primarily to meet the increasing demand of workers and labor organ-

izations for such information. Distribution of the Labor Information Bulletin is on a request basis.

Women's Bureau, U. S. Department of Labor.—A recent bulletin published by the Women's Bureau summarizes the data available on the extent and seriousness of occupational diseases of women workers. Legislation enacted for the compensation and prevention of such disease is discussed and an analysis is presented of the extent of the recording and reporting by the various States and Territories. The findings of the bulletin show scattered and incomplete reporting of occupational disease by the States and as a result inadequate legislative aids for its prevention. Besides the Federal Government, only 12 States, 3 Territories, and the District of Columbia provide compensation for occupational disease, and in 7 of these only certain diseases are covered by the law. Only 11 States have published any data on occupational disease since 1920. Only 6 States have data by sex, and 2 of these do not publish them. Although the total numbers of women affected can not be determined because of the large degree of under-reporting, shocking conditions have been found where special studies have been made. The bulletin suggests a well organized program for the prevention of industrial diseases that would include the substitution of harmless chemicals in manufacturing processes or the provision of adequate safeguards, including compulsory periodic physical examinations. The inclusion of occupational disease in State compensation laws and the complete and standardized reporting of such disease also are recommended.

The wide variations in the payment to women of wages for the same work under practically identical conditions is shown in a study recently made by the Women's Bureau. The study includes 412 plants, constituting a sampling made in 1932 or 1933 of wage rates or earnings in 8 important woman-employing industries in 17 States scattered in all sections of the country.

Federal Reserve Board.—Carl E. Parry, until recently Assistant Director of the Division of Research and Statistics of the Federal Reserve Board, has been made Chief of the newly created Division of Security Loans, which is charged with administration of the sections of the Securities Exchange Act of 1934 that are in the jurisdiction of the Board and have to do with the fixing of margin requirements for credit extended by brokers, banks, or other persons for the purpose of purchasing or carrying securities.

Woodlief Thomas, who for some time had been a member of the staff of the Division of Research and Statistics of the Federal Reserve Board, was appointed an assistant director of the division in November.

Lauchlin Currie, formerly a member of the faculty at Harvard University, who since last summer been engaged in research in the monetary field in the Treasury Department, has been appointed an assistant director of the Division of Research and Statistics.

Others who have recently joined the staff of the Board's Division of Research and Statistics are: Leroy M. Piser, formerly with the Section of Financial and Economic Research of the Treasury Department and before that for several years with the Reports Department of the Federal Reserve Bank of New York; John Bergelin and Roland Robinson, formerly at the University of Michigan; and Martin Krost, who had been employed at the Treasury Department during the summer.

Lewis N. Dembitz has been transferred from the Division of Research and Statistics to the Division of Security Loans.

Brookings Institution.—The Brookings Institution is conducting a preliminary administrative survey of the State of Oklahoma. This is being done through the Institute for Government Research under the immediate direction of Dr. Arnold Bennett Hall. The subjects are education, welfare, revenue, and financial administration.

Dr. L. F. Schmeckebier of the Institute for Government Research is assisting the Liquor Study Committee of New York. His work has to do with the administrative features of alcohol control.

Report on Elimination of Waste In Distribution.—A sub-committee on elimination of waste in distribution of the Business Advisory and Planning Council for the Department of Commerce recommended in January that a complete census of distribution be taken every five years, that a 10% sample of establishments in the field of distribution should be studied annually, that a census of population be taken every five years instead of every ten years, and that a census of manufacturers be placed on an annual basis with a larger quinquennial enumeration. The sub-committee reported that necessary data for investigation of cyclical and long-time fluctuation in distribution are lacking and can be remedied only by extending the basic reporting system. Members of the sub-committee are: Lew Hahn, Chairman; Bruce Barton, Col. Robert G. Elbert, Dr. Paul Nystrom, J. Sweetser, Herbert J. Tily, William E. Woodward, and Alexis Sommaripa, Executive Secretary.

Joseph Guinchard, chief of the Municipal Statistical Service of Stockholm, Sweden and member of the International Institute of statistics, died on November 14, 1934.

Meredith B. Givens has been granted six months' leave from the staff of the Social Science Research Council, to act as Director of Industrial Studies in the Division of Research and Planning of the National Recovery Administration. Mr. Givens continues to act as Executive Secretary of the Committee on Government Statistics and Information Services, and serves as its representative on the Central Statistical Board. The staff activities of the Committee were completed December 31, 1934, and Mr. Givens is now giving his full time to the National Recovery Administration.

A. M. Fox who has been with the United States Tariff Commission in Washington eleven years, ten years as chief of its Economics Division, has been promoted to the newly created position of Director of Research.

Winfield W. Riefler has resigned his position as Economic Adviser to the Executive Council and Chairman of the Central Statistical Board to accept a professorship in the Institute for Advanced Studies, Princeton, N. J.

Professor Lawrence H. Seltzer is on leave of absence from Wayne University, Detroit, Michigan, and is serving as Head Economic Analyst in the Division of Research and Statistics, Treasury Department, Washington, D. C.

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REVIEWS

Calculation and Interpretation of Analysis of Variance and Covariance, by George W. Snedecor. Ames, Iowa. Collegiate Press. 1934. 96 pp.

The analysis of variance is a concept ascribable to R. A. Fisher which includes as special cases a large number of statistical methods, such as the comparison of the means of two samples or of two regression coefficients, and deals also with situations in which there are three or more samples, and in which there are cross-classifications. The distribution of ratios of independent estimates of variance discovered by Fisher makes possible the comparison of dispersion among class means with the dispersion to be expected on account of random sampling, in view of the observed intraclass variance, and thus to discover whether the principle of classification used was significantly related to the variate measured. Though the examples given by Fisher pertain chiefly to crop yield experiments, the method is applicable to a great variety of social and scientific observations. An extension needed where two or more variates are measured simultaneously is the analysis of covariance. The algebra and calculus of the analysis of variance were presented by J. O. Irwin in the *Journal of the Royal Statistical Society* for 1931. Professor Snedecor in this little volume describes the methods appropriate to various cases by means of arithmetical examples.

For a large number of potential users of modern efficient statistical methods, this manual will be an invaluable desk companion. It is clear, simple, explicit, and correct. The mathematics in it ought to be intelligible to a grammar-school graduate, yet it will be of service even to the most advanced research workers in economics, sociology, biology, psychology, medicine, physics, chemistry, and astronomy. There is, of course, a danger in the use of any mathematical method whose theoretical basis is not thoroughly clear to the user, but the chances of an intelligent reader of this book going wrong in the use of its methods do not appear to be serious.

Substantial reductions in the cost of statistical investigations and experiments are consistent with increased accuracy when efficient methods are used in the design of the experiment and the calculation of the results. Such methods as the Latin square arrangement, which increase the amount of information without increase in the number of cases, are here clearly explained. Fisher's table of 1% and 5% points is replaced by one which does not require the use of hyperbolic logarithms, and which is more detailed.

It is possible to take issue with a statement on p. 13 that the validity of an analysis of groups with unequal frequencies depends on the assumption that the varying frequencies in the sample groups are representative of those in the population from which the sample was drawn. A valid and perfectly accurate test for the reality of interclass variance is possible with unequal

groups, the proper assumption underlying the sampling distribution being simply that in the infinite aggregate of samples with which the one in hand is compared, the frequencies in each class are the same in all samples. There is, however, a peculiarity in the analysis of variance with unequal frequencies, in that while Fisher's sampling distribution can tell us whether there is evidence for the existence of a real source of variation among classes, it can provide us with accurate fiduciary limits for the ratio of interclass to intraclass variance only when the class frequencies are equal. The failure to understand this point has given rise to various errors in recent discussions, though not in this book.

One might wish that mention had been made of the fact that the applicability of the methods with full accuracy is limited to samples from normally distributed populations. But the proper tests of significance for non-normal distributions must depend on the solution of mathematical problems concerning which we have at present only glimmerings, and adequate discussion of this and many other relevant questions must await future research. As a practical brief account of what is now known and as a computer's handbook, Professor Snedecor's work is highly satisfactory and will find many appreciative users.

HAROLD HOTELLING

Columbia University

Statistical Methods for Research Workers, by R. A. Fisher. Fifth Edition. Edinburgh: Oliver and Boyd. 1934. xiii, 319 pp.

Each new edition of Dr. Fisher's treatise contains fresh discoveries. Previous editions have been reviewed in this Journal for 1927 (p. 411), 1928 (p. 346), 1930 (p. 381), and 1933 (p. 374). The current volume is notable for an exact treatment of the problem of independence in a 2 x 2 table, together with an improved approximation attributable to F. Yates, to be used in the chi test when the numbers of cases in some of the cells are small. There is also a new method of modifying least-square calculations when one of the variates is discarded.

The section introduced into the fourth edition under the name of "The Analysis of Covariance" is here extended and made considerably more explicit. This treatment should make the method useful to a wider circle.

HAROLD HOTELLING

Columbia University

The Technique of Social Investigation, by C. Luther Fry. New York: Harper and Brothers. 1934. xii, 315 pp.

Social surveys, researches, and investigations have in the last three decades assumed the proportions of a major industry. The universities have responded with courses aiming to train researchers. The resulting need and market for textbooks on the subject has brought forth a number of volumes.

The bulk of them are manuals of statistics. But recently some of these texts have given more attention to the planning, financing, and detailed management of field studies and the human problems which they involve. The volume under review is distinctly of the latter nature.

In the course of his years of experience as director of the bureau of standards of the Institute of Social and Religious Research, the author had opportunity to observe scores of studies, mainly of the survey type. His book is a systematic discussion of the practical problem of initiating and carrying to completion inquiries of this kind. Beginning with chapters on planning a study and the use of secondary sources, the author follows with excellent discussions on direct observation, interviewing, questionnaires and enumerations, experimentation and tests, qualitative and quantitative analysis, writing the report, and disseminating the findings. Finally, there is a chapter on the "Possibilities and Limitations of Social Research", and an excellent annotated bibliography occupying one-fifth of the book.

It would be impossible to disagree with any of the excellent advice to young researchers, which makes up the bulk of the volume. Its eclectic style and richness in concrete illustrations should make it a popular elementary text. Since this is its primary purpose it should be adjudged a success. The author is less convincing in his occasional digressions into the theoretical and scientific aspects of research. We find, for example, the customary worry about the "psychic" factors in social research and the usual misunderstanding or misrepresentation of the attitude of the behaviorists toward these phenomena. Thus, the behaviorists are alleged to "ignore the realm of ideas [and] claim that psychological factors in society do not really count"(!) (p. 10). Another author is accused of taking for granted that "the ultimate purpose of social research is to arrive at generalizations or laws" (p. 173). All that the author in question takes for granted is that the ultimate purpose of *scientific* social research is to arrive at generalizations. Will any scientist dispute the assumption? To those who use the term "scientific" as an adjective of praise instead of merely a description of a kind of inquiry which by definition aims at generalization, the above distinction will seem a reflection on the value of the type of research discussed in the volume under review. Surveys of this kind aim primarily, if not entirely, at the solution of immediate practical problems and, as such, no one questions their value as desirable bases for propaganda, reform, and other important social purposes. But such investigations have no necessary relation whatever to science, no matter how carefully they are executed.

Indeed, it is because these studies consist for the most part of just that "welter of facts that have little meaning" which the author properly deplores that they are largely useless to science. Again the author attributes their lack of meaning to the proper source when he says that "scholars have failed to erect the intellectual edifice of theory which is so essential to give significance to our data-gathering" (p. 240). These theories are necessarily in the nature of generalizations, and they derive their ultimate support from data

carefully gathered and analyzed *with reference to some generalization.* It is the repetitive accumulation of data and generalizations of this sort out of which the edifice of science in any field grows, rather than from the unrelated, sporadic, and "practical" surveys which today consume the bulk of the funds available for research. As for the statement that "sociological research is in a class with history rather than with industrial chemistry," (p. 238) one may at least hope that these alternatives do not exhaust the possibilities. But these theoretical considerations are really apart from the admirable qualities of the book noted at the outset.

GEORGE A. LUNDBERG

Columbia University

Les Fluctuations Economiques A Longue Period et La Crise Mondiale, by François Simiand. Paris: Librairie Felix Alcan. 1932. 142 pp.

This volume is a series of lectures delivered by Professor Simiand at the Institute des Haute Etudes de Belgique, Brussels.

Professor Simiand presents two main theses: (1) That since the end of the 18th century, and probably even since the 16th century, economic development has been subject to long-run, wave-like fluctuations; (2) the present world crisis is more than a phase of the more or less normal business cycle of eight to ten years and is rather a turning point between two phases of these long-run fluctuations.

This point of view is the familiar one which has previously been presented by Kondratieff, Spiethoff, Woytinsky, and others. The periods which Professor Simiand presents, and which he explains largely in terms of price movements, are the familiar ones from 1789 to about 1815–18, as the first major upward phase; 1850 to 1875–80 as the second upward phase; and the end of the 19th century up until after the World War as the third upward phase; the downward phases following in each case these periods. He suggests that there may have been previously even a longer-run wave movement, the upward movement running from the beginning of the 16th century to about the middle of the century. Professor Simiand believes that these fluctuations reveal themselves not only in price movements but also in the total amount of production, the downward phase being represented by a declining rate, or even occasionally with an actual regression in the volume of production. In this connection, it may be noted that the indices of production which are available, such as those of Snyder, are an inadequate representation of industrial production, since they deal primarily with basic raw materials.

Professor Simiand advances the view that the movement of prices seems to constitute a regular antecedent of the movement of production, distribution, and general economic relations, and that this movement of prices itself appears to be anticipated by variations in the rate of increase of the monetary medium. From this relationship, the conclusion appears to be reached that

the rate of increase in the volume of monetary medium is a basic factor without which these major fluctuations cannot be understood. Professor Simiand, however, guards against a premature interpretation of these long-run fluctuations in terms of monetary phenomena, particularly against a crude application of the sufficiency of the gold supply in terms of a "normal" increase in gold. Professor Simiand also finds inadequate the explanations that run in terms of such circumstantial factors as the World War and its results, the post-war state of public finances, the international debt situation, and the post-war accumulation of gold by France and the United States. Similarly, he does not find satisfactory the overproduction or underconsumption explanations, or the alleged disequilibrium between cost (notably wages and prices), the technological developments, or the explanations which run in terms of waves of pessimism and optimism.

Professor Simiand believes that the development of the downward phase of the long-run economic fluctuation is an inevitable unfolding of the process of economic progress initiated in the preceding upward phase. The upward and the downward movements represent two phases of a coördinated process, and, indeed, economic progress could not occur without finding expression in some such manner as that represented by these two phases of economic development. Economic life, which is dynamic, and which progresses from one economic form to another, must of necessity find expression in a succession of disequilibria. The progressive development of economic life can only be realized by forward jumps, so to speak, and the subsequent adaptation and adjustment to the new economic data. These developments find their expression in the upward and downward phases of the long-run economic fluctuations.

In this process, there is harsh selection or weeding out among enterprises, among different categories of production, among industries and branches of production, and even among different regions and different countries. This causes economic suffering and strife, both internal and international. Protectionist devices are developed in terms both of domestic institutional arrangements and of nationalistic movements. These are the more or less instinctive reactions to the prevailing economic pressures. No panaceas can be found to remedy the situation for the reason that none exist. Neither the upward nor the downward phase of the long-run economic fluctuations is pathological; each phase of the movement is a necessary part of the whole process. Since economic progress cannot unfold itself in terms of static equilibrium, it inevitably follows that it must be achieved in terms of a certain cost of human difficulties and frictions, and even suffering. Professor Simiand, however, points out that the attempt to guard against these evils and to minimize their effects in either phase of the movement is a fully legitimate effort and is not at all without reason or possible result. Professor Simiand also warns against the conclusion that his analysis of the economic necessities in the unfolding of economic progress amounts to a "sanctimonious optimism" on the one side, or a "Mohammedan fatalism" on the other.

To sum up Professor Simiand's contribution: Professor Simiand makes an analysis of the modern and contemporary economic development of a progressive society. This analysis indicates that such development is characterized by long-run fluctuations, by alternating phases opposed yet related to each other, which together make up and make possible the realization of what is called economic progress. The analysis points out that in the unfolding of the downward phase, after a harsh selection and weeding out process, a new adaptation is made which prepares the way for further advance to the advantage of those forms of economic organization which are best equipped to make rapid adaptations to the new situation.

ALVIN H. HANSEN

University of Minnesota

Primi Lineamenti di Statistica Corporativa, by G. Pietra and P. Fortunati. Instituto di Statistica della Regia Università di Padova. Padua: Tipografia Antoniana. 1934. 137 pp.

Anyone familiar with the aberrations which have become current in certain sectors of academic life in Fascist Italy under the title of "corporate economics" will be forgiven for approaching with some trepidation this volume on "corporative statistics," particularly since Professor Pietra, in his introductory essay (p. 20), claims a place for his "corporative statistics" by the side of "corporative economics." One has visions of the sort of product which is promised in Soviet Russia whenever the authorities there decide to press their demand that a certain Russian physicist undertake to rewrite mathematical physics on the basis of the Marxian dialectic.

Fortunately, however, the absurdity of the suggestion that statistical theory shall take a special form in a Fascist state, though it is certainly no whit more ridiculous than the suggestion that economic theory should take a special Fascist, or "corporative" form, was too much for the two authors of the book under review. For example, the formulas for index numbers of quantity and price, which are given by Professor Fortunati on p. 70, would feel perfectly at home in any textbook on statistical method published in a decadent "liberal" state; and if some readers may have scruples with respect to the formula for the measurement of the "stickiness of prices" given on p. 86, these scruples will have to be based on other grounds than that the formula has a Fascist tinge.

"Corporative statistics," in fact, turn out to be nothing more nor less than "the statistical method applied to the corporative phenomenon" (p. 20). Non-Italian readers will therefore confine their scruples to a questioning of the grounds on which Professor Pietra, in particular, attempts to justify his claim that "corporative statistics" represents a "new branch of applied statistics." In what sense "new"? It is not necessary to raise the question whether the specific acts of economic policy for which the Fascist régime has been responsible are in fact as "new" as good Fascists imply they are, though

such a question might profitably be raised, not only with respect to the acts of the Fascist régime, but also with respect to the acts of other "régimes" closer home, for whose acts a similar degree of "novelty" has been claimed. Let us grant that they are "new"; is one forced to conclude that the statistics recording the basis for and the results of these acts must represent a "new branch of applied statistics"? A new variety of tomato is grown; shall we then have a "new branch of applied statistics," called, perhaps, "New Tomato Statistics"?

Indeed, when one examines the specific grounds on which "corporate statistics" are distinguished from the statistics obtained on the basis of the "old ordinances of the liberal State," one wonders at the possibilities of self-deception under a régime in which comfort lies precisely in the direction of self-deception. What Professor Pietra says, for example, with respect to the difference between a "liberal régime" and a "corporative" one, in the matter of the use of statistics for purposes of forecast (pp. 12 ff.), will seem to most readers merely amusing. And when he implies (pp. 12, 20) that the use of statistics for the purpose of "control" is a peculiarity of the "corporative régime," he is merely giving countenance to that absurd caricature of "liberal" economic policy which suggests that a "liberal" state was never known to legislate on anything. In fact, of course, all the major problems of "liberal" economics, from the days of the Corn Laws through the Restriction Period and the Currency and Banking School Controversy down to the theory of imperfect competition, have been problems which grew out of the feeling that "something ought to be done" about these things; and out of this feeling has come not only the development of economic analysis, but also the collection and the use of such statistics as could be made to bear on the problem in hand.

One fears, indeed, that the real differences between "corporative statistics" and "liberal" statistics are of a kind that Professor Pietra and Fortunati would not be free to discuss, even if they desired to do so. There are, for example, reasons for doubting whether it would be possible, in Fascist Italy, for "corporative statistics" to deal as adequately with what Professor Pietra himself calls the "very delicate" matter of unemployment (p. 11), or, perhaps, with the equally "delicate" problem of the pressure of taxation, which Professor Fortunati mentions in passing (p. 87), as could the statistical studies which might have been published under the despised "liberal" régime. But to call statistical studies of the latter type "liberal," as opposed to "corporative," would be to suggest acceptance of what in certain Fascist countries has become an article of faith, namely, that traditional disciplines and received truth have authority only in so far as the "regime" chooses to lend them that authority. Perish the day when that article of faith will be accepted by the rest of the world!

ARTHUR W. MARGET

University of Minnesota

Production Trends in the United States Since 1870, by Arthur F. Burns. New York: National Bureau of Economic Research. 1934. xxiv, 363 pp.

In his introduction Wesley C. Mitchell characterized this book as "the most important contribution to our knowledge of increase in production which has been made since Mill." And with good reason.

This same introduction contains a concise and efficient summary of the study, covering scope, general procedure, and findings. Few who read the summary will be able to drop the book without a careful study of its contents.

Mr. Burns first appraises the data with which he must work—revealing thereby the pains with which he has scrutinized his materials and weighed their defects. In the second preliminary stage, he discusses the concept of secular trend, appropriate methods for its measurement, and means for analyzing these measurements.

The body of the work presents annual percentage rates of trend change for overlapping decades centered at five-year intervals. These constitute the basic data for the analysis. The divergence of these rates for different industries, and for the same industry at different times, the general retardation in these relative rates of growth, and the long-run cycles in them are the analyses explored with a fine balance of statistical elaboration and economic reasoning. The book concludes with a highly enlightening chapter on the problems involved in the measurement of total production. In the appendices are available the original data and the statistics derived from them.

As exposition of research, the book has but one serious flaw. The elimination of cyclical influence from the decade rates should have been made absolutely clear, preferably with numerous chart illustrations. Although there is no positive reason whatever for doubting the excellence of Mr. Burns' technique, we are never clearly informed just what was regarded as "cyclical bias" and just what were the criteria for deciding that such bias was absent from the decade rates. Consequently we cannot be quite certain as to the meaning of the fundamental data of the study.

THEODORE O. YNTEMA

University of Chicago

The New York Money Market, by Benjamin Haggott Beckhart, James C. Smith, and William Adams Brown, Jr. Vol. II, "Sources and Movements of Funds," xi, 395 pp. Vol. III, "Uses of Funds," xii, 475 pp. Vol. IV, "External and Internal Relations," xiii, 606 pp. New York: Columbia University Press, 1933.

The New York money market is the money market of the whole country. Borrowing and lending of short-term funds takes place in large volume elsewhere, but it is largely of local significance whereas the movement of funds in and out of New York affects and is affected by monetary conditions throughout the country to a degree that applies to no other center. In view

of the importance of New York in our banking and credit structure, it is fitting that the Council for Research in the Social Sciences at Columbia University should sponsor a series of comprehensive studies of the New York money market.

The first volume of these studies, a well-written analytical history of the development of the New York money market from 1791 to 1913, prepared by Margaret G. Myers, was reviewed in this Journal for March, 1933. Volumes II, III, and IV, now under review, treat of different phases of developments in the market since 1913. Since this market is the center of the banking and credit structure of the United States and an important international monetary center, these volumes cover a broad field. They present in organized form a mass of information which will be useful both to students of banking and credit and also to those who are engaged in directing operations or determining policy in these fields.

Volume II, after an introduction briefly describing some of the institutions of the market, presents an analysis of the reserve basis of money market funds, covering a field of study developed within the Federal Reserve System and elsewhere and previously described in detail by W. W. Riefler in "Money Rates and Money Markets in the United States," as well as in current publications of the Federal Reserve Board and banks. Professor Beckhart's study of these factors is not limited simply to the supply of reserve funds available in the New York money market but considers factors affecting the supply for the country as a whole. In parts three and four of Volume II, Professor Smith discusses the concentration of funds in the New York money market and the ebb and flow of funds to and from that market. Part three gives an excellent discussion of the factors which have been responsible for the development of the New York money market to its position of dominance in the country. Special emphasis is rightly placed on the concentration of bankers' balances, with a discussion of the reasons why the establishment of the Federal Reserve System did not bring this concentration to an end, as was anticipated by many students of the problem.

In Volume III, which is concerned with the uses of funds, special emphasis is given to brokers loans and to the acceptance market, with brief discussion of the commercial paper market. Professor Beckhart's analysis of the important developments in brokers loans during the decade of the 20's presents a useful summary of the various heated discussions of that epoch. The importance of the street loan market as the central money market of our credit system is emphasized.

The section on the acceptance market furnishes a comprehensive survey of the development of that market, together with a full discussion of the legal framework of the acceptance and a description of the institutions of the market. Emphasis is placed by the author of this section, Professor Beckhart, on the policy of the Federal Reserve banks of encouraging by preferential rates the development of the market for acceptances. He holds the

view that the preference given this market has sometimes interfered with the adoption of a consistent credit policy by the Federal Reserve System.

Volume IV, entitled "External and Internal Relations," begins with an appraisal of Federal Reserve policy from 1923 to 1931 by Professor Beckhart. This appraisal is discussed below. Professor Brown furnished a section on the Government and the money market, which gives a summary of the fiscal policies of the Treasury before the war, and a full analysis of these policies during and since the war, with special reference to the effect on the money market and on Federal Reserve policy. This section of the study is well written and will be particularly useful for reference purposes.

The final section of the book, prepared by Professor Smith, discusses seasonal and other periodical fluctuations in bank credit movements. The rôle of the New York City banks in maintaining stability in the market in the face of these periodic movements, as for example at end-of-month and middle-of-month settlement periods, is demonstrated by this analysis. Considerable data are presented showing various banking series for each Federal Reserve district, together with numerous series of business statistics, designed to explain the variations.

The principal use of these volumes will be for reference purposes. They will probably be found too long and detailed for general reading. Their usefulness might have been enhanced by separation of description of organization and operations from analysis of trends and policies. Much of the detailed material could have been placed in appendices. Some statistics not heretofore available and many useful and informing compilations of previously published figures are given in these volumes. From the standpoint of arrangement, much fault could be found with the statistical tables. Many of them conceal rather than reveal the important facts or comparisons that they are supposed to set forth.

Professor Smith's sections on the ebb and flow of money market funds and on periodicities furnish many statistics not previously published, although much unpublished work has been done in studying this subject. This is essentially an analysis of factors that influence the balance of payments among the various regions of the country and is similar to the problem of international balances of payments. Unfortunately, however, owing to the lack of adequate figures, one of the most important factors in a balance of payments analysis—the volume of trade in goods and services—is not measurable between districts.

Another difficulty is the problem of obtaining a satisfactory definition of "funds." If what is meant is simply the net gold movement, the Gold Settlement Fund figures may provide the answer. The problem, however, is more largely one of determining what is the significance of the flow, i.e., for what purposes are the funds used—to build up bankers' or other deposit balances, to lend on the street, to buy securities, to buy goods, or to pay off debts. A decrease in bankers balances in New York may indicate that bank customers have been sending funds to New York for commercial or financial purposes,

whereas an increase in bankers balances may reflect a flow of commercial funds out of the city.

For these reasons most studies of this subject have led to inconclusive results, and Professor Smith's study is likewise unsatisfactory from this standpoint. It is, however, a careful analysis of the problem and is worth presenting for the use of other students who may be attracted to this field, as well as a warning to them of the difficulties.

Considerable space is devoted to appraisal of Federal Reserve policy from 1923 to 1931, with particular emphasis on the brokers loan situation in 1928 and 1929. Professor Beckhart, who wrote the section dealing with these topics, holds that the expansion of bank security loans, real estate loans, and investments during this period was a reflection of an increase in bank reserves beyond the credit needs of business. The increasing importance of assets of this type held by banks, as contrasted with commercial loans, caused a deterioration in the liquidity of bank portfolios and was largely responsible for later difficulties. In his final summary, the author seems to place most of the responsibility for the accumulation of reserve funds on Federal Reserve bank open-market operations in 1924 and 1927, although in the course of his analysis other factors are mentioned, such as the inflow of gold resulting from the country's international balance-of-payments position, the release of reserve funds by the shift of bank deposits from the demand to the time category, and the decrease in money in circulation. There is also some discussion of changes in corporate financial practices, which not only reduced demands for commercial loans, but also provided corporations with funds which they could lend out on the street.

This appraisal concludes that banks in seeking uses for a supply of funds that exceeded the credit needs of business increased their street loans and their investments. Yet in another section Professor Beckhart devotes considerable space to demonstrating that the funds employed by banks in street loans are not surplus funds, as has been claimed by many writers. All of them, of course, are not; some represent the use by New York City banks of primary reserves held for other banks, some are secondary reserves which banks can readily draw out when needed, some grow out of established customer relationships, and at times some are supplied by New York City banks for the purpose of maintaining a stable market. The important question, however, which is not even stated in a clear-cut manner in these volumes, much less answered, is whether the tremendous increase in brokers loans was made possible by the availability of surplus funds or by attracting funds from other uses.

The author does not place all emphasis on the supply of funds. Due consideration is given to the fact that the methods of margin trading in this country have been such as to stimulate speculation and to encourage borrowing for the purpose, without regard to rates or other restrictions. It is clearly indicated that the close relationship between stock market activity and the central money market in this country may unfavorably affect the stability

and soundness of our banking and credit structure. The ability of the stock market to direct the flow of substantial amounts of credit into certain channels makes that market a factor of considerable influence in our economic system.

In discussing other controversial questions some of the opinions advanced are more or less dogmatically expressed and need further support to be convincing. Controversy about the question of absorption of credit in the stock market might have been lessened by a clearer definition of terms, distinguishing between absorption and diversion of credit. In regard to liquidity of bank assets, it is doubtful whether many bankers would be convinced by the arguments presented that brokers' loans were not the most liquid of all loans. The case against their liquidity from a broader economic point of view could be stated more convincingly. The statement that there was in the 20's an increase in the volume of bank credit beyond the needs of business would also meet with disagreement in some quarters, and adequate evidence was not presented in support of this view.

Since this review has been delayed for so long a time after publication of the books, it is possible to point out the number of important subjects discussed the nature of which has been radically changed by new legislation and other developments within the past two years. Some of these changes were recommended by the authors. Much of the basic material used in their volumes was collected by the Senate Banking and Currency Committee in preparation for the Banking Act of 1933. The prohibition in that Act against the payment of interest on bankers' balances, as well as on other demand deposits, will presumably have some effect on the concentration of funds in the New York money market. Restrictions placed on the payment of interest on time deposits provides a tool which can be used to discourage any future tendency to shift deposits from the demand to the time category. Restrictions placed by clearing house action as well as by the Banking Act of 1933 and the Securities Exchange Act of 1934 on brokers' loans by non-banking lenders will help to prevent such loans from again becoming the disturbing factor that they were in the 20's. The Securities Exchange Act, with its limitations on stock trading and especially with its margin provisions, is designed to place restrictions on the demands for credit to be used for speculative purposes and provides instruments of control which were not available in the past decade. Various provisions of the Banking Act of 1933 give the Federal Reserve Board power over banks which it did not previously possess.

There have also been changes which, contrary to the conclusions of those volumes, have tended to remove restrictions. Monetary legislation has removed a number of technical limitations placed on Reserve banks in reference to the holding of gold reserves against notes and deposits. The question of "free gold," to which some space was devoted in this study, has been eliminated by this legislation. Instead of placing greater restrictions on the eligibility requirements of discounts at Reserve banks, the tendency of emer-

gency legislation has been to lighten these requirements. The influence of the Government in monetary and credit matters has been increased rather than diminished. The effect of deposit insurance, which was not foreseen or discussed by the authors, on banking and credit developments remains to be tested.

WOODLIEF THOMAS

Washington, D. C.

Moneylending in Great Britain, by Dorothy Johnson Orchard and Geoffrey May. New York: Russell Sage Foundation. 1933. 176 pp.

There is nothing new under the sun. That, at least, is the impression we gain from "Moneylending in Great Britain." For this skilfully-patterned history of customs, laws, and judicial interpretations uncovers ancient methods of law-evasion which the casual student might believe to be peculiar to our own time and our own country. This volume is the fourth in the Small Loans Series published by the Russell Sage Foundation. The final volume, by Louis N. Robinson and Rolf Nugent, is in preparation.

The trickery of lenders and the harsh treatment of borrowers which gave the business of moneylending its early unsavory reputation resulted, as "Moneylending in Great Britain" clearly shows, quite as much from law as from avarice. The Canon law prohibited the taking of interest and the church courts enforced the law. Later, when foreign commerce increased the need for borrowed capital, the demand was met not by changing the law but by countenancing a host of evasions, ranging from perversions of the insurance principle and spurious assumptions of risk to loans disguised as sales of goods. And the King's officers found it convenient to ignore all these abuses except when the condition of the Royal Exchequer—the need of balancing the budget—created a "national emergency" which made it "patriotic" to sieze the property of the moneylenders.

The financing of consumption did not become a distinct enterprise until, about the turn of the sixteenth century, deposit banking was developed by the scriveners and the goldsmiths. Lenders operating on their own capital then turned to the making of small loans. Never as badly cramped as bankers by the usury laws, in 1854 moneylenders were freed from all restrictions by the repeal of those laws.

The new freedom was soon abused. For half a century, however, regulatory legislation did not aim to control the rate of interest but confined itself for the most part to protecting lenders, borrowers, and third parties, in the event of default on the part of the borrower. Restrictions placed on the British form of the chattel mortgage became so onerous that lenders turned in preference to the promissory note, a preference which is still shown.

A new philosophy of regulation appeared in the Moneylenders Act of 1900. This Act empowered the courts to review any transaction brought to their attention and to relieve the borrower if the bargaining had not been straight-

forward or if the interest rate was excessive. The Act was too feeble to accomplish its purpose, but the aim persisted in the Moneylenders Act of 1927. Now all lenders must be licensed; they must confine their advertising within the strict limits set down by the law; they must inform the borrower fully of the conditions and terms, including the annual rate of interest charged; and they may not compound interest on interest in the event of default. While the courts are left free to decide for each case whether the terms are "harsh and unconscionable," the burden of proof rests upon the lender if the rate exceeds 48 per cent per annum. In actual practice the courts hold that no interest rate *per se* is too high. Each case is considered with reference to all the attendant costs and risks.

"Moneylending in Great Britain" tends to prove—what some of our own states have learned through costly experiments—that all laws which attempt to establish a maximum price of the use of money are readily evaded whenever they fix the rate lower than supply and demand would fix it. Enforced truth-telling of licensed lenders rather than rate regulation is the chief protection of the borrower against the unconscionable lender.

This study is of value to the student of consumer finance because it presents the development of British law with conscientious attention to detail and with ample reference to original sources. The treatise is of value to the general reader as well because of the faithful delineation of social and economic settings and the careful appraisal of the effectiveness of each law. The style is lucid, terse, straightforward. Political factors—so important in the American struggle for social reform—are not discussed, perhaps because the authors consider such a discussion out of place in this particular study.

WILLIAM TRUFANT FOSTER

Pollak Foundation for Economic Research

Taxation of Foreign and National Enterprises: A Study of the Tax Systems and the Methods of Allocation of the Profits of Enterprises Operating in More than One Country, by the League of Nations. Vol. I: France, Germany, Spain, the United Kingdom, and the United States of America. 1932. 275 pp. Vol. II: Austria, Belgium, Czechoslovakia, Free City of Danzig, Greece, Hungary, Italy, Latvia, Luxemburg, Netherlands, Rumania, and Switzerland. 1933. 467 pp. Vol. III: British India, Canada, Japan, Mexico, Netherlands, East Indies, Union of South Africa, States of Massachusetts, of New York, and of Wisconsin. 1933. 254 pp. Vol. IV: Methods of Allocating Taxable Income, by Mitchell B. Carroll. 1933. 219 pp. Vol. V: Allocation Accounting for the Taxable Income of Industrial Enterprises, by Ralph C. Jones. 1933. 78 pp. (Published at Geneva).

This work stands unique in the field of taxation in its devotion to detail on the one hand and its wide geographical range on the other. Thirty-five countries are covered by the report, which contains contributions by thirty-

seven authors. Since the chief purpose of the study was to compare the treatment applied by the several countries to the problem of allocating taxable income with respect to enterprises doing business in more than one country, it was essential to obtain a certain degree of uniformity. This has been achieved through the device of subdividing the subject matter in the same manner for every country. The first section of each study describes the existing system of taxes on income and property levied by the national government; these descriptions are sufficiently detailed to be useful to all tax students, regardless of their interest in the particular problem of allocation. The second part distinguishes the taxes applicable to foreign and to national business enterprises, noting the treatment accorded such items as dividends, interest, rents, etc. The third and concluding section describes the methods of allocating taxable income.

In the fourth volume, Dr. Carroll summarizes the information presented in the first three volumes, and in his last chapter, "Prerequisites for a Régime of Allocation," he analyzes the points at issue and presents his conclusions. An additional degree of cohesiveness of the study as a whole is achieved by Professor Jones' contribution on allocation accounting. Thus one of the greatest dangers facing such an extensive research project has been avoided through careful recapitulation and analysis.

The splendid achievement represented in these five volumes may well be a source of pride to those responsible for it, especially the members of the Fiscal Committee of the League, under whose auspices the work was carried on, the Rockefeller Foundation, which financed the study with a grant of $90,000, and Dr. Carroll, who in addition to his substantial contributions in Vols. I and IV planned and controlled the project as a whole. Finally, the work stands as a tribute to the energy and skill of the late Professor Thomas S. Adams, through whose efforts the study was initiated.

CARL SHOUP

Columbia University.

The Supply and Control of Money in the United States, by Lauchlin Currie. Cambridge: Harvard University Press. 1934. xvi, 199 pp.

Dr. Currie has written this book because he believes that the supply side of money has been inadequately analyzed and presented. It is the reviewer's opinion that the author is not only correct in this contention but that he has provided an analysis of the supply aspect of money which should not be ignored by those who must deal with this subject.

Parts I and II of the book are devoted to a closely reasoned analysis of the meaning and implications of the supply of money, and here the statistician working in the field of currency supply will find analyses and conclusions which he should inspect. The author's conclusions—and the book is literally packed full of them—are of such a challenging nature that it seems highly probable that they will provide a basis for several statistical excursions into

the field of money supply in order to test the accuracy of the author's work. Considering also the great number of challenging arguments advanced against commonly accepted notions of the proper functions of central banks, one may suspect that reactions of central bank students to this little book will prove both mixed and interesting.

The first two parts of the book reveal a high type of analysis, if one assumes its accuracy, and indicate genuine ability on the part of the author to traverse with ease the most difficult ground of commercial and central banking. The work should constitute a challenge to advanced students of central banking regardless of whether it irritates or pleases them by the tone and method of approach to the subject.

In Part III the author presents his suggestions for reform. It is the reviewer's opinion that this part of the work is in nature a pronounced anti-climax when compared with the preceding analysis and that found in the appendix devoted to "The Interpretation of the Federal Reserve Statement and Related Items." The author's "solutions" are of an unorthodox sort. He urges a central banking institution dominated by the Government with complete control of the monetary supply placed in the hands of a Government-appointed body, which would be responsible only to the President. The author's program is vague, and the plan very incompletely portrayed; and this section of the book is far from lucid. The reviewer could not visualize just what kind of a banking structure the author would have, but stripped of its veneer and of the austere dignity characterizing the analysis which preceded it, the plan seemed to be quite like the typical proposal for a central note-issuing institution emanating from former Senator Owen, the Committee for the Nation, and other bank-note inflationists. Recognizing that his suggested plan may be impracticable, the author suggests as temporary expedients what he considers to be less radical changes in the present banking structure.

The book overlooks, in the reviewer's opinion, several very fundamental considerations which must enter into a study of the theories of central banking. The tone of the book doubtless will impress readers as somewhat high-handed and critical. The author has little respect for the judgment, policies, or accumulated experiences of the Federal Reserve Board, the Federal Advisory Council, the Bank of England, or the Committee on Bank Reserves, which made its report in 1931. The reviewer believes the author challenges too lightly the accumulated lessons of central banking, and that much of his analysis and certainly his major conclusions will require considerable checking before they will have any wide acceptance among the experienced and well-informed students of central banking.

Doubtless it is merely a slip of the pen when the author mentions (p. 110) $341 million greenbacks, instead of $347 million, and their backing as $150 million gold, instead of $156 million gold.

WALTER E. SPAHR

New York University

The Divorce Court, Ohio, by Leon C. Marshall and Goeffrey May. Baltimore: The Johns Hopkins Press. 1933. 440 pp.

This volume is the second in a series of factual and objective studies of divorce, the first having been made of the Maryland record. In the preparation of this particular work, the authors had the assistance of the Judicial Council of Ohio, the Ohio State Bar Association, and the Institute of Law of the Johns Hopkins University. It is a painstaking, thorough, judicial survey and analysis of the law, the dramatis personae, and the realities of the divorce procedure.

The authors point out that there is no integrating agency in matters of divorce law in Ohio, and in some details the divorce law "is not far short of anarchy." The statutes have laid down the "barest requirements," and the divorce court judges themselves, being in the main free agents, have brought about a great diversity in the actual interpretation and administration of the law. There are at least eighty-eight judges. Emotional bias and personal philosophy become the actual law in many instances.

This does not mean a "breezy booming confusion." The courts function admirably for those seeking a divorce. Of the suits filed in the period studied (July 1–December 31, 1930), only 0.8 percent were denied. "Gross neglect of duty"—a conveniently elastic phrase—is charged in two-thirds of divorces granted. "Anyone who believes divorce law to function in practice in Ohio as it reads in the law books is a proverbial ostrich. . . . A divorce decree will be duly assigned to anyone who has a certain amount of time and money—and a cooperative spouse."

Measured by the average annual number of divorces granted in the three years 1929 to 1931, Ohio, with more than 14,000 divorces, stands fourth in the list of states (Texas is first with 17,000). In the rate of divorces per 1,000 population, Ohio, with a rate of 2.15, stands seventeenth in rank. Generally, the states that outrank her are in the west. Only Florida, Indiana, and Michigan, in the east, have higher rates. The increase in divorce in Ohio may be graphically stated: sixty years ago there was one divorce to every twenty-five marriages; today there is one divorce to four marriages. This increase is more rapid than that for the United States as a whole, though the increase has been largely in Cuyahoga County, in which Cleveland is situated.

For the student of divorce many interesting facts are brought out. Because of the ease with which a divorce may be secured in Ohio, it is frequently asserted that people desirous of severing the marriage tie flock there. The data do not confirm this belief.

What relationship exists between age at marriage, the duration of the marriage, and divorce? Nearly two-fifths of the persons covered in this study (37.8 per cent) were minors when they were married. The wives were, on the average, several years younger than their husbands, more than one-half (54.5 per cent) of them having been minors at marriage. Three-fourths were under twenty-five. The median age was 20.5 years. The hus-

bands were older, only one-fifth having been minors at marriage. The median age was 24.7 years. (How this compares with the situation existing in the general population of Ohio the authors do not know.) The bulk of the principal litigants married fairly early in life. The authors conclude that, insofar as the data can be trusted, "earlier" marriages (unless very early) survive for a longer period and that "marriages contracted when *either* party is thirty or more years of age terminate distinctly sooner than do the marriages contracted at an earlier age." Divorces reach their height in the first full year in which divorce is readily possible under the legal grounds. Of the divorces studied, 37.5 per cent concerned marriages of less than five years standing. The median duration of all marriages covered in the divorce records studied was just seven years.

It is frequently contended that the presence of minor children acts as a deterrent to divorce and that childlessness is a major cause of marital discord. An examination of the data from Ohio does not bear out these assumptions. Minor children were present in 45.0 per cent of the cases coming to court and are *recorded* as present in three-fourths of the suits filed by wives when the marriages have endured 20–24 years.

When the divorce court has granted a decree it is difficult to have the decree vacated even when fraud on the part of the litigants is proven. Methods to prevent fraud on the residence requirements have failed. "The attorney for a plaintiff evading the requirements has been tried for subornation of perjury, but his conviction was reversed. The court could probably not commit a plaintiff for contempt in making a false declaration of residence. . . . And when a divorced husband went so far as to bring action for conspiracy to alienate his wife's affection against his wife's relatives and lawyers and the common pleas judge who granted the divorce decree, it was held that a finding by the judge that the wife had complied with the statutory requirements could not be inquired into in such an action, and the action was dismissed."

How horrible must this state of affairs seem to an English judge who, in such cases, will send out the king's proctor to investigate when there is the slightest reason to be suspicious of the truthfulness of the litigants or the private morals of the plaintiff. Although the situation in Ohio is probably not greatly different from that in many of the other states in the Union, it raises the question, "Why should Americans respect the law?"

RAY H. ABRAMS

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Recent Developments in Industrial Group Insurance, by National Industrial Conference Board, Inc. New York: National Industrial Conference Board. 1934. 46 pp.

This report is a revision and an extension of a similar study made by the National Industrial Conference Board in 1927 and revised in 1929. It contains a brief historical account of the development of group insurance and

definitions of the several forms. It attempts no objective analysis of the movement which began in 1911 with group life insurance. To this type there have been added group accident and health, group annuities and pensions, and group accidental death and dismemberment insurance plans. The report gives data not only of the Board's statistical researches but also of others in this field, the final one having been made in 1934. Added to these are the figures of the eight largest companies writing more than 90 per cent of this branch of the business.

On December 31, 1933, these eight companies had in force group life insurance covering nearly four and one-half million employees, with an average policy per employee of $1,828. Group accidental death and dismemberment insurance protected slightly more than half a million, with an average policy of $1,473. Nearly one and one-quarter million employees were protected by group accident and health contracts providing an average weekly benefit against such contingencies of $13 per week. Less than 200,000 employees were covered under group annuity and pension plans calling for an average monthly income of $43.53. Many concerns carry combinations of some or all of these insurances on their employees. The net number covered, therefore, was about five million wage earners. In a sense, this fortunate group may be said to constitute the aristocracy of American labor.

The greater share of the benefits are extended to employees of the largest concerns. The smaller the concern the less is the protection received by the employee. While group insurance declined materially in 1931, 1932, and 1933, it has, nevertheless, held up exceedingly well. At present there is about nine billion dollars of all forms outstanding. Although group insurance represents the best among the voluntary efforts of capital to protect labor, it provides only a slight approximation of labor's need of a well-rounded social security program.

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Population Theories and their Application with Special Reference to Japan, by E. F. Penrose. California: Food Research Institute. Stanford University. 1934. xiv, 347 pp.

This book is a distinctive contribution to population theory, not only for its clear summarization of the principal points in the development of the Malthusian and Neo-Malthusian doctrines, but also because it introduces several important new aspects of the subject and gives an admirable correlation of recently developed theories. Furthermore, the book brings into relationship with the theory of population the various statistical contributions which have been made in recent years. While it does not abound in statistical data and has not a single table or chart, it is nevertheless to be classified as a befitting and creditable advance in the quantitative treatment of population doctrines.

There are several fields of endeavor in the social sciences where we have seen so many contributions admirable in detail and in statistical analysis but so diffuse and so lacking in basic interpretation that we are disposed to a feeling of more or less hopeless dismay and ask "what does it all mean?" Dr. Penrose's book on *Population Theories and their Application* is the answer to the social scientist's prayer in this respect. To one who has even a passing familiarity with the various quantitative studies which have been made in population problems, this book constitutes reading of absorbing interest and stimulation. For the general population theorist, it will undoubtedly prove to be a welcome and almost despairingly-hoped-for interpretation of the variety of "tricks" he has seen the statisticians perform in their quantitative inquisition of his beloved doctrines.

Pure theorists will be delighted with the author's remarkable successful efforts to attain consistency and clear definition of conceptual meanings. In his treatment of the optimum density theories, for example, he attempts to develop a distinction between an income optimum density and a welfare optimum density. For long years, leading economic theorists have tried to make an impression upon the economists in special fields of study concerning the importance of making that distinction, which is so fundamental to the interpretation of price economics versus welfare economics. Dr. Penrose's concept of a welfare optimum density will be criticized by some, no doubt, because he attempts to give it an objective reference. An apparently studious insistence on quantitative interpretation is slightly obtrusive in parts of the book, but the author develops the subjective and psychological aspects of most of the problems taken up. One conspicuous exception is his discussion of the problems arising, in connection with migrations, from genetic and cultural differences, where he seems content to let the case rest on the basis of the quantitative analyses made by the special students in these fields (circa pages 234–238). Even in this case, however, he mentions the subjective aspects of the problem (page 243).

The book is exceptionally well documented and manifests a wide familiarity with recent works on the subject. Lorimer and Osborn's *Dynamics of Population* came out a few months after Dr. Penrose's book was published.

Dr. Penrose has divided the book into three parts. Part I is called "Theories of Population," in which the successive chapter titles are: i, the Malthusian theory; ii, the income optimum population; and iii, the welfare optimum population. Part II is called "Some Aspects of the Japanese Population Problem," in which the chapter titles are: iv, the increase of population; v, population, food, and agriculture; vi, prospects for industrialization. Part III is called "The Distribution of Population and the Distribution of Natural Resources," in which the chapter titles are: vii and viii, population and migration; ix, population and territorial expansion; x, population and international trade; and xi, population and conflict.

JAMES G. SMITH

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A Study of the Chinese Population, by Chi-Ming Chiao. Foreword by Edgar Sydenstricker. New York: Reprinted from the Milbank Memorial Fund *Quarterly Bulletin* for October, 1933, and the *Quarterly* for January, April, and July, 1934. 56 pp.

In the absence of governmental registration of births and deaths and of official census taking in China, Chi-Ming Chiao's *A Study of the Chinese Population* is very illuminating and suggestive. It is the analysis of a survey of 12,456 families in 22 localities in 11 of the provinces of China, covering nearly 68,000 persons. The data were collected in connection with the land utilization study that is being carried on at Nanking University, and the localities were so distributed as to be fairly representative of rural China as a whole. The sample is small in comparison with China's total population, but it reveals the probable characteristics of that population better than any study hitherto made. The author's division of the country at the Huai River, into North and South China, though geographically proper, is not entirely satisfactory for this study, because all but two of the localities included in the sample for South China are situated in the Central China provinces, where there has been a greater degree of industrialization than in the North or the South. His comparisons between North and South China are therefore more truly between North and Central China, because the industrialized centers have very definitely affected the composition of the population in the central area. It is quite probable that a survey limited to Fukien and the two Kwangs would reveal a much higher degree of similarity to North China.

On the basis of the data collected, the author discusses the Chinese family, the age, sex, and marital composition of the population, birth and death rates, and natural increase. The discussion of sex composition is one of the most interesting sections. It reveals a high ratio of males to females, which the author attributes in part to faulty reporting and in part to infanticide or neglect of girl babies. Even after an allowance for these factors, however, there still seems to be an unexplained excess of males, which is all the more interesting because of the drain of males from the country in large-scale emigration. The material is simply and clearly presented, and the author's analysis is well worth reading.

JOHN E. ORCHARD

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Industrial Policy of India, by C. N. Vakil and M. C. Munshi. Calcutta: Longmans, Green and Company, Ltd. 1934. xii, 271 pp.

This book is the seventh volume in a series of studies on Indian economic problems edited by Mr. Vakil. Since various economic difficulties which plague India are treated in previous volumes, the present volume is confined primarily to a discussion of the customs tariff as an aid toward economic improvement in India. The preface, introductory chapter, and chapters I to III inclusive by Mr. Vakil contain a discussion of Indian industries, the

general post-war tendencies toward protective tariffs, and the past, present, and future tariff policy of India. Most students of economics will be disappointed to find no analysis of international trade theory which is properly considered the basis for tariff policy. The excuse for the omission (p. vii) is that protective tariffs are now the popular fashion among the family of nations. To the reviewer a statement of a few international trade and finance principles which tend to support the limited use of protective tariffs would have been preferable to this excuse.

The chapters on policy initially set maximum production and consumption (p. 1) as a goal for Indian economic development, but on the same page and subsequent pages the goal is stated as "maximum production with a national outlook." To maintain consistency the reader should overlook the first statement. A possible way out of the inconsistency, not explored by the author, would have been to state the effects of industrialization on the growth of population in other countries and to maintain that industrialization in India, promoted by tariffs, would eventually raise the level of consumption for a smaller population. Effective protection for the domestic market and encouragement of the export trade is the policy outlined to achieve the desired goal. The possession of a raw material (pp. 6–7) is accepted as evidence of a trade advantage in the manufacture of its finished products. If countries import raw materials and encourage the export of their finished products, they are (pp. 5–6) guilty of economic imperialism. No stigma, however, is attached to the same export practice if the exporting country possesses the raw material. Frequently the comment is made that the taxpayers in one form or another pay for the protection of industries. To the reviewer the accepted distinction between the incidence of tariffs and bounties is important.

Students of tariff problems, particularly those in India (excluding, of course, proponents of imperial preference in the British Empire), will find the brief tariff history of India in chapter II and the analysis of the present tariff schedules in chapters IV to VII both interesting and instructive. The latter chapters contain a discussion of ad valorem versus specific duties; valuation practices; classification of tariff commodities; tariff methods and procedure; and a detailed, proposed tariff schedule for India. Appendix I (Customs Tariffs as a Source of Revenue), appendix II (The World Economic Conference), and appendix III (The Cost of Protection) occupy thirty pages. Their material might more appropriately have been included in the pertinent chapters and not merely attached to the end of a chapter. The authors' position with regard to a bargaining tariff for India (cf. ch. II and pp. 164 and 190) is not clear. The highly commendable effort to devise methods for measuring the burden of protection in India (pp. 81–85 and 254–66) is marred somewhat by the statement that with the application of the methods in India (p. 266) "the system of protection will almost reach perfection."

CLIFFORD L. JAMES

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Labor Fact Book II, by Labor Research Association. New York: International Publishers. 1934. 222 pp.

Women Who Work, by Grace Hutchins. Prepared under direction of Labor Research Association. New York: International Publishers. 1934. 273 pp.

Labor Research Association is a non-profit undertaking that collects and interprets current economic facts as they impinge upon the status of labor. The Association was founded in 1927 "to conduct investigations and studies of social, economic, and political questions in the interest of the labor movement." As part of its activities it is also publishing a series of monographs, the "Labor and Industry Series," one of which, *Labor and Steel,* by Dr. Horace B. Davis, was recently reviewed in this *Journal* (June, 1934).

The two books under review, though not of this series, nevertheless are of the same general character and purpose. *Labor Fact Book II* (*Labor Fact Book I* was published in 1931) is not, therefore, as one might be led by the title to conclude, a mere book of facts or statistics, not even "labor" facts or statistics. It is rather a systematic analysis of such facts and statistics. Thus, the book deals with the nature of the economic crisis, with capitalist efforts to solve it; with the effects of the crisis on the American worker, white and Negro, on the poorer farmer, and with the struggle of these classes of society against the lowering of their standards of living and for a measure of increased economic security.

One chapter deals with the meaning and practices of Fascism; one covers the threat of a new imperialist war; another describes recent progress in the Soviet Union. The definition of "Fascism" and the conception of the part it plays in the present crisis of world capitalism may be cited as examples of the seriousness with which a "Fact" book may be endowed.

"Fascism," the authors quote the Executive Committee of the Communist International, "is the open, terrorist dictatorship of the most reactionary, most chauvinist and most imperialist elements of finance capital." "The growth of fascism, therefore," Labor Research Association explains, "indicates the growth of the revolutionary crisis. . . . The capitalists are no longer able to maintain their dictatorship by the old methods of bourgeois democracy. . . . Capital is therefore forced to undertake open terrorist dictatorship. . . ."

Most of the statistics in the book, taken from the most authoritative sources, are of course not original with *Labor Research Association.* In several instances, however, their treatment reveals facts not commonly known. Examples may be found in their tables pertaining to strikes and to the class distribution of Federal income and expenditures. They point out, for instance, that between the fiscal years 1928–1929 and 1933–34 the proportion of the Federal income received from "corporations, wealthy individuals and middle class" declined 43%, whereas that received "from workers and consuming masses" increased 53% (p. 61).

The book contains valuable appendices and reference notes and is well indexed.

Women Who Work, by Grace Hutchins, is a factual study of the especially onerous lot of women workers under capitalism. Nearly 30% of women wage earners in the United States, Miss Hutchins points out, are married, and the vast majority of these have the double burden of a job and the taking care of children and a home. They have no maternity leave or maternity insurance; no child nursery law nor provision for the care of woman workers' children. Besides, health standards for working mothers are flagrantly violated, if any there be on the statute books. "Old at 30" is the result. "Old" for most jobs open to women, excepting at the two extremes, the professions and menial house day work.

There follow the familiar facts that women's earnings "range from 20% to 70% below men's earnings. . . . In bread and bakery products, fruit and vegetable canning, and confectionery in New York, women earn less than half of what men earn."

But the book is not a statistical study. It is full of human documents drawn from the experience and personal investigations of an apparently indefatigable worker. There are more than five pages of closely typed "Reference Notes."

The book closes with the two chapters on woman's growing participation in the struggle for immediate demands for the improvement of her lot as well as for a revolutionary change in the economic system which, according to Miss Hutchins, would set her free along with her men fellow workers from capitalist exploitation. Under Socialism in the U.S.S.R., Miss Hutchins contends, both are free of exploitation and are economically equal.

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Operating Results of Department and Specialty Stores in 1933, by Carl N. Schmalz. Bulletin No. 92, Bureau of Business Research, Harvard University. 1934.

Expenses and Profits of Variety Chains in 1932. Bulletin No. 93, Bureau of Business Research, Harvard University. 1934.

Chain Store Expenses and Profits, by Malcolm P. McNair. Bulletin No. 94, Bureau of Business Research, Harvard University. 1934.

These three studies are retail cost analyses which the Bureau of Business Research at Harvard University carries forward more or less continuously. The *Operating Results of Department and Specialty Stores in 1933,* which is issued annually in cooperation with the National Retail Dry Goods Association, is used by department stores generally as a basis for comparison of their own results with those of other department stores. Owing to reduced expenses and higher margins, the operating data show the first reversal in the steady downward trend in earnings which began before the depression. Excluding sales taxes, the tax burden of department and specialty stores in

1933 increased by about one-fifth in percentage of sales over 1932. A special tabulation shows sales tax information for the 16 states which had such a tax in operation in 1933. This information is of value in keeping in touch with the growth of Federal and state taxes and the progress of sales tax legislation.

An attempt is made in this bulletin to show the relation between expenses, sales, and operating results for stores which appeal to different clienteles. Tentative conclusions are that quality appeal stores have a higher average sale, higher expenses in cents per transaction, and higher percentage margins than price appeal stores. No generalization is made concerning profits or stock turn. Although at present somewhat inconclusive, such information should increase in value as the experience of additional years is accumulated. A real need exists for this type of analysis.

According to *Expense and Profits of Variety Chains in 1932,* 29 chains, representing 5,027 stores and aggregate net sales of $670,000,000, showed a net gain of 2.2 per cent. On the average, the large chains operated at a profit, whereas the smaller chains lost money. Variety chains in general have shown a drop in average sales per store every year since 1928. This situation, with an essentially unchanged tenancy cost per store, brought about a sharp shrinkage in profits during the 1928–32 period.

In *Chain Store Expenses and Profits,* operating data are reported for 24 department store chains, 16 department store ownership groups, 23 shoe chains, 34 drug chains, 39 grocery chains, and 29 variety chains. Although some of the samples from which data were drawn are not as large as would be desirable and although some of the data are two or three years old, the Bureau is undoubtedly providing a useful service to those interested in retailing by bringing together such information, thereby maintaining the continuity of its reports on chain store retailing.

All these publications are carefully worked out from a statistical and accounting point of view, and comparability with past reports has been maintained through adherence to standards which the Bureau has developed. They are equally valuable as guides to operating practice for business people and as sources of data for business analysts.

L. H. GRINSTEAD

Armour & Company